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THE COMING SOLAR ECLIPSE.

ARTHUR K. BARTLETT.

A total eclipse of the sun, visible as a partial eclipse throughout North America, is to occur on the afternoon of June 8, which will be the most popular and interesting celestial event of the year and for which extensive preparations have been made by astronomers. The eclipse will appear total over a narrow belt about 60 miles in width extending diagonally across the United States from Astoria, Oregon, to Orlando, Florida, and it will be of greater magnitude the nearer the path of totality the observer is located. It will be the first in the series of three eclipses announced for the present year, and the only one visible in this country except a small partial eclipse of the moon to occur on June 24.

In 1917 the world was favored with seven eclipses, four of the sun and three of the moon—the greatest number possible in any one year—but the smaller number this year will be fully compensated for by the eclipse of June 8, which will occur under the most favorable conditions of time and season. It is considered of so much importance that a large and costly pamphlet was recently published by the Nautical Almanac office under the authority of the Secretary of the Navy, which contains elaborate tables and many excellent charts, together with special instructions for observing the spectacle. Occurring as it does at a delightful season, it will doubtless attract more than ordinary attention and be observed with great interest throughout the country, should the weather prove favorable. A telescope, though affording a more satisfactory view, will not be necessary for observing the eclipse, it being seen almost equally well by the naked eye protected, of course, by a smoked glass, which is all that will be required in order to observe its progress and general features to good advantage.

The eclipse will begin in the western part of the Pacific Ocean, east of the Philippines, at sunrise, and in the eastern portion of its path within the United States the total phase will continue about one minute and in the western portion about two minutes. From an

elevation located within the belt of total eclipse the moon's dark shadow may be seen advancing eastward over this narrow track with terrific speed, travelling the 3,000 miles in only 47 minutes, but the velocity will be least on the Pacific and greatest on the Atlantic coast. As viewed from lower Michigan and the upper middle States about three-fourths of the sun's disk will be covered by the moon, but as the distance to the southwest increases toward the path of total eclipse, more of the sun will be obscured until in the center of the narrow belt the greatest magnitude will occur.

The moon being near her descending node, crossing the ecliptic from north to south, she will pass over the sun in a southeasterly direction, and the earth being near aphelion or farthest from the sun the solar disk will appear somewhat smaller than usual. The moon being also only three days after perigee or nearest to the earth will appear a little larger than usual, and these two favorable conditions of the sun and moon will cause the eclipse to be of longer duration than it otherwise would be. The phases will occur at different local times as seen in various parts of the country, but in the new central standard time as at present adopted, the eclipse will begin at 5:30 p. m. and end at 7:24 p. m., the partial phase continuing about two hours as seen from the middle part of the United States.

The photographs of this eclipse will be more numerous than ever before, and an attempt will be made for the first time to secure moving pictures of the spectacle which, if successful, will be exhibited throughout the country, being an innovation in celestial photography which cannot fail to prove of great educational value. Special attention will be given to the corona, that wonderful halo of pearly light never seen except during a total eclipse, extending outward in beautiful forms to a great distance from the sun, at times in long tongues of flame which contain the mysterious gas "coronium," not found on the earth, and are believed to affect our weather in some way unknown. The corona will be repeatedly photographed, as will also the red solar flames known as "prominences," which often shoot up half a million miles from the sun's limb and are composed mostly of hydrogen and calcium gas. Another feature that will receive attention is the mysterious "shadow bands," or peculiar dancing waves of light and shade observed to move over the landscape just before and after a total eclipse, which have never been satisfactorily explained and are still awaiting a solution. Some observers of the eclipse will doubtless search for the suspected planet Vulcan, believed by many astronomers to revolve around the sun within the orbit of Mercury, the existence of which has never been confirmed, though diligently looked for during the total phase of various former eclipses. If there is really such a planet it is believed that

it will surely be discovered on the photographic plates exposed to the sun and its vicinity during the total phase of the coming eclipse.

A total eclipse of the sun is one of the grandest and most impressive phenomena of nature, but it is an event of very rare occurrence at any one place on the earth's surface. During the 19th century only seven total eclipses of the sun were visible in the United States, and not one has been visible in London since 1715, none having been visible there for five and a half centuries previous to that year. There cannot be more than five nor less than two solar eclipses each year visible to some portion of the earth, but the eclipse of June 8 will be the first total darkening of the sun to occur in this country since May 28, 1900. The late Professor Young in his "Elements of Astronomy" says: "Solar eclipses that are total somewhere or other on the earth's surface are not very rare, averaging one for about every year and a half. But at any given place the case is very different; and since the track of a solar eclipse is a very narrow path over the earth's surface, averaging only 60 or 70 miles in width, we find that in the long run a total eclipse happens at any given station only once in about 360 years."

It is a remarkable fact that the city of Denver, Colorado, which was favored with the total eclipse of July 29, 1878, should lie in the direct path of the coming eclipse, making the second total eclipse to visit that locality within forty years. A large party of astronomers are preparing to observe the spectacle from the top of Pike's Peak where a clear and excellent view may be obtained at an elevation of nearly three miles above the sea level.

A total eclipse of the sun visible in Mexico is to occur on July 11, 1991, which will be the most favorable in history, and according to Professor David P. Todd, an authority on solar eclipses, "It will occur at noon, in mid-heaven, near the zenith, and will be a rare eclipse which will be highly prized by astronomers. The longest total eclipse of which we have authentic record in the past was 6 minutes 20 seconds in duration, and the longest that can ever happen under the most favorable conditions has been calculated to be 7 minutes 58 seconds. The great eclipse of 1991 will be total in the city of Mexico during the unprecedented interval of 7 minutes 10 seconds. It will afford an unexampled opportunity for solar research, and no eclipse in past history has ever presented in any land such an array of attractive possibilities."

Doubtless there are many persons in every community who have never seen an eclipse of the sun, especially under favorable conditions, and the one so near at hand will afford an excellent and not often-repeated opportunity to gratify the curiosity anyone may have to witness such a phenomenon, which probably more than any other

celestial spectacle, first attracted the thoughts of men to the study of astronomy. Even in this enlightened age, when the cause and nature of eclipses are so well known, there are perhaps few persons who can witness the gradual fading away of the sunlight during a solar eclipse, and realize the accuracy with which its prediction is verified, without feelings of awe, astonishment, and admiration. Modern astronomy having enabled men not only to explain the nature of eclipses, but also to foretell their coming with remarkable accuracy many years before they occur, has disrobed them of their former terrors and dispelled the ignorance with which they were observed in ancient times, and such phenomena are at present anticipated with delight by all intelligent persons rather than with the superstitious dread which they seemed well calculated to engender in the earlier ages.

A solar eclipse being caused by the moon coming between the sun and our earth, such an event can occur only at "new moon", when the moon is in conjunction with the sun, all three bodies being in a straight line with each other. At the time of a solar eclipse the moon's conical shadow passes over some portion of the earth, and to all places within the shadow, or a limited distance outside of it, an eclipse, either total or partial, will occur, the sun being more or less obscured according to the position of the observer. There are more eclipses of the sun in a given time than of the moon, and yet at any one locality eclipses of the moon are more frequent than those of the sun, owing to the fact that the former are visible from more than one-half of the earth, while the latter are confined to a narrow region, which in a total eclipse seldom exceeds 150 miles in width, and in a partial eclipse 4,500 miles at the greatest.

If, at the time of a solar eclipse, the moon is in or near the part of her orbit most distant from the earth, her disk will appear smaller than usual, and then she is not quite large enough to cover the sun entirely, leaving a part of the sunlight exposed to view around the black disk of the moon, appearing as a bright ring and producing what is known as an annular eclipse, so named from the Latin word annulus—a ring. A total eclipse can never last quite eight minutes at any one place, the duration usually being not more than three or four minutes, and sometimes only a few seconds; but the time a solar eclipse may continue is influenced by the axial rotation of the earth, which increases the duration from what it would otherwise be owing to the great velocity of the moon's shadow, which moves over the earth at the rate of 2,300 miles per hour—a speed sufficient to carry it across the earth's disk in a little less than four hours.

While in the eclipse so near at hand the sun will not be completely hidden over the greater portion of the country and the glorious corona

cannot be seen except where the phase is total, it will nevertheless be of much interest to the amateur astronomer and the general public as a rare phenomenon, worthy of observation, and demonstrating the accuracy of celestial prediction. The moon moving toward the east much faster than the sun, traveling over her own diameter in about one hour, will overtake the latter from the west, the eclipse beginning on the right side and ending on the left side of the sun, differing in this respect from an eclipse of the moon, which always begins on the left side and ends on the right side, as the moon is obscured by her passage into the earth's shadow, which first intercepts the moon's light from the eastern portion of her disk. The magnitude of this eclipse will depend upon the distance of observers from the central part or axis of the moon's shadow, and the amount of sunlight obscured will diminish as the distance of the observer increases from the narrow belt in which the eclipse will be total.

An interesting feature of a partial eclipse, when the moon has advanced some distance over the sun, is the peculiar appearance of shadows cast by the foliage of trees. The little images of the sun cast upon the ground between the leaves, instead of forming a circle as usual, will assume the form of the partially eclipsed sun, which will finally resemble the crescent moon, and the crescent will become narrower as the eclipse progresses until the middle is reached. The images of the sun will appear larger in proportion to the height of the foliage above the ground, being about one inch in diameter for every ten feet. As the shape of the sun's outline gradually changes, so will the shape of the images on the ground, and the horns of the crescent-shaped images will be in the reverse direction to the horns of the actual crescent of the sun at the time, the sun's rays crossing as they pass through the foliage, just as if each opening were a lens.

When the sun's disk has been covered to the greatest extent, if the observer has a good spy-glass or opera-glass, with a dark glass in front to protect the eye, the rough and jagged outline of the moon, caused by its mountains and valleys, will be plainly visible projected against the bright background of the sun, which in strong contrast will present its usual soft and uniform outline. The moon may be easily seen passing over sun spots, and it will be worth noticing, when the sun is most obscured, whether the moon's limb can be traced outside the sun's disk.

It will not be safe to observe the eclipse with the naked eye, and no one should make the attempt, but a good view may be obtained with an ordinary opera-glass. A shade should be used next to the eye, and it would be a good plan to fasten a piece of paper or leather over one of the glasses and use only the other. The shading glass can then be

held by the hand in front of the instrument and rapidly changed for one more suitable if three or four colored glasses of different shades be provided beforehand. If a smoked glass be used in front of an opera-glass or telescope, the observer should not forget to turn the smoked surface away from the eye, and special care should be exercised not to injure the sight in any way.

Those who have neither opera-glasses nor telescopes, and will be obliged to observe with the naked eye, may obtain a good view of the eclipse by looking at the sun reflected from a blackened mirror, but a much better view will be procured by the customary method of observing through a smoked glass. Some precaution is necessary in smoking the glass to avoid cracking it by heating any one portion too suddenly. The glass should be smoked lightly at one end over a candle (or better, over a little piece of camphor gum burning in a saucer), and the shade gradually deepened to almost total blackness at the other. It can then be shifted along past the eyes until the most suitable tint is found, giving a clear view without dazzling. By this simple means, preparing a smoked glass and using it in the manner described, a very satisfactory view of the eclipse may be obtained if clouds do not prevent, besides making the light safe for the eyes, and with an opera-glass bringing out clearly the spherical aspect of the sun's globe.

The gradual progress of the moon over the sun's disk will be worth seeing, with proper protection, during the entire continuance of the phenomenon; but when an eclipse is only partial the most interesting and exciting time, especially to amateur observers, is the moment it begins, the moon first appearing as a dark spot upon the edge of the sun's disk, and announcing the imposing spectacle that is to follow. Observers should watch for the first contact of the moon with the solar disk, indicated by a black notch upon the sun's western limb, which will gradually become larger until the middle of the eclipse, when the greatest obscuration will occur. As the moon appears "jet black" during an eclipse, the beginning of her passage across the sun may be easily recognized, and observers should prepare for the moment when their curiosity will be the most aroused.

The eclipse being of considerable duration, ample time will be allowed for all to witness the grand spectacle, the weather permitting, and no one should miss seeing the free exhibition for which no "reserved seats" will be required. But those who wish to observe the phenomenon should not forget the event and must remember that it will wait for no one, or they will find themselves in the unpleasant predicament of the old woman who, desiring to see an eclipse through a large telescope, arrived too late and asked the astronomer if it could not be "shown over again" for her benefit.

Battle Creek, Michigan.

SIMPLE OBSERVATIONS WITH A SMALL TELESCOPE.

VERA M. GUSHEE.

While the large and complicated instruments of an observatory are generally inaccessible to the average observer, there are fortunately other means of satisfying our natural desire for telescopic aid. Hasty glimpses through even the best telescopes are often disappointing. The constant use of even a very small instrument, on the other hand, offers unlimited opportunities for studying the celestial bodies under the most varied conditions, and thus, for the amateur, furnishes an ideal substitute for more elaborate apparatus.

Much can be accomplished with the naked eye alone. Still no one will deny the importance of optical aid in almost any field of astronomical work. In fact it is usually considered indispensable whenever useful results are to be attained. But it does not follow that the amount of pleasure or interest derived or the value of the resulting observations is proportional to the size of one's instrument (or to its magnifying power). These factors depend more upon the individual observer than upon his tools. I believe it is possible to find a maximum degree of pleasure, and an unlimited source of interest in the use of a home-made telescope only one and one-half inches in aperture, especially if that telescope happens to be one of your own construction.

Many simple observations which are not possible for the naked eye come within range of such an instrument. We shall find, in fact, that nearly all the objects most commonly shown to visitors through the telescopes of an observatory lend themselves quite readily to observation under lower powers, for if they do not, at first sight, present such a striking appearance, the image, if it is sufficiently clear cut and definite, is almost sure to allure us into a closer study of its details, so that the discovery of all that can possibly be distinguished with the means at one's command becomes the dominant interest.

A brief summary of the observations undertaken with my small one and one-half inch telescope (described in a previous article) may serve to give a general idea of the possibilities of a home-made instrument. Beginning within the solar system the first and in many ways the most satisfactory object to observe is the moon, which proves a source of never-ending interest and delight. Next to our friendly satellite the planets naturally receive the most attention, especially Jupiter, Saturn and Venus, when favorably situated. Mars, in spite of its charm for

the imagination, is likely to disappoint the amateur observer using only low powers. Yet it is interesting to observe this planet as well as the others, for it makes us realize as never before the difficulties which accompany such observations even when conditions are nearer to the ideal. As for the most distant planets of our system, Uranus and Neptune, if we succeed in seeing and recognizing them in the telescope we must be satisfied, for it is no easy matter to distinguish them from the neighboring stars. Outside the solar system, there are hosts of nebulae, double stars and star clusters, some of them visible to the naked eye, whose beauty is vastly increased by the telescope, others revealed only through optical aid, all of which add infinite variety to one's observing, while comet observations furnish an element of novelty.

In choosing from such a varied list the advantages of the one and one-half inch telescope soon become evident, advantages which apply equally well whether the student formally elects a course in astronomy at school or college, or undertakes to increase his knowledge of celestial phenomena through his own efforts at home. On any particular night one is at liberty to choose whatever especially suits the fancy. Not so with the experienced astronomer, who must as a rule limit his attention to some special line of work best adapted to his abilities and equipment. But the amateur, who is not required to specialize, may spread his efforts over a wide range of interests, touching upon all the most attractive and alluring aspects of the science.

Let us turn our telescope first of all to the moon, which on account of its nearness and surface irregularities presents a striking appearance even under a low power. One look into the eyepiece is enough to disclose delightful possibilities, but hours of close attention are necessary to appreciate fully what is thus revealed. If the phase is not too near the full, the most characteristic features stand out boldly, especially along the terminator, which is the boundary between day and night on the lunar sphere. The dark patches known as the "maria" or "seas," which appear indistinct and hazy to the naked eye, become now so clear that their outlines may be readily traced. In sharp contrast to these comparatively low and level plains are the rugged areas about them. It is here that we find the mountain ridges and the countless crater-like formations which on close study offer a great variety of detail. The appearance of the terminator, ever changing as the phase waxes or wanes, may often be likened to the uneven coast-line of a continent with peninsulas, bays, and tiny islands. The latter, appearing like bright points of light surrounded by total darkness, are in reality the peaks of the loftiest mountains which catch the light of the rising and setting sun.

On consulting a moon-map we can identify many of the most prominent objects, finding perhaps on the first night a list of fifteen to twenty, including craters, mountains, and "seas". And this is only a beginning! Succeeding observations will doubtless reveal much more, for our eyes become gradually better trained and we shall study the surface at different phases, when it appears under varying conditions of light and shade and when the same objects, although viewed many times before, seem to possess new and interesting details.

As the phase progresses toward the full the image comes to occupy practically the whole field of our telescope and many interesting features are obscured by the direct rays of the sun, leaving only the general outlines of the "maria" and the largest craters. But at the same time another phenomenon becomes most striking and that is the effect, only partially reproduced in photographs, of the bright lines diverging from some of the largest craters and especially from Tycho, near the top of the image. These radiating streaks give to the moon an appearance similar to a globe upon which meridian lines are drawn with Tycho as the north pole. While special aspects of these and of other lunar features are brought out by larger telescopes, it is at the sacrifice of the total effect just described as well as the general form of the "maria"; for, as the magnifying power is increased, the part of the image contained in the field of view at one time is correspondingly diminished.

While there is still much to be gained by a continued study of our satellite, we are nevertheless anxious to try our telescope on other worlds. Let us examine some of the brighter planets whose courses among the stars, it is to be hoped, have been previously followed by the naked eye, so that they may now be located readily. When Jupiter is favorable for observation and the telescope is turned in its direction a small but bright disk is revealed and the four largest satellites can be easily discerned. Our interest soon becomes attached to these tiny points of light which appear sometimes all on one side of the planet, sometimes separated by its disk, but always nearly in the plane of the planet's equator. A change in their relative positions may often be noted in one evening by allowing an interval of an hour or two to elapse between observations. In this way we may observe what appears like a miniature solar system and can actually perceive its working, while viewed edgewise, that is with our eyes nearly on a level with the plane in which the moons revolve. There is surely no better way to gain a true conception of the fundamental laws governing the relations and motions of the heavenly bodies.

Another object almost as interesting for us as Jupiter, although its image is smaller and therefore requires closer scrutiny, is the planet

Saturn. As we watch the image sail into the field of view, our first impression is of a tiny object with a conspicuously oval outline. With a little patience and steady observation the elongated portion of the image seems to separate from the ball within, allowing the dark background of the sky to intervene on both sides, and we see a perfect miniature representation of Saturn and its rings. Often these glimpses are momentary, occurring only at the instants of "good seeing" when atmospheric conditions and the eyes of the observer are at their best. But the difficulty thus experienced serves to make the result more valuable when one considers the training in acuteness of observation. If we fail altogether to see the rings it may be no fault of the telescope or of our eyes but due instead to the position of Saturn in its orbit, for when the rings are tipped to the plane of the earth's orbit they become lost for a time to terrestrial observers with small telescopes.

Venus, as morning or evening star, is doubtless the most beautiful of the planets to the naked eye, and we are therefore ready to seize the first opportunity to view her through the telescope. Owing to the bright rays of light diverging from the center of the image, our first telescopic observation of our neighbor planet may be rather unsatisfactory, though it is usually possible to distinguish the phase which, if Venus is evening star and at greatest elongation from the sun, will resemble that of the moon at first quarter, the lighted half being at the left since in the telescope the image is inverted and reversed. When Venus is farther along in her orbital course we see the crescent phase. If a cardboard disk with a hole in its center be placed over the object glass, thus eliminating some of the objectionable light rays, the shape of the image, even though it is very tiny, is quite evident.

After observing the moon and the nearer planets, these being comparatively easy telescopic objects, we are ready to try something more difficult. It may be a good time to begin the search for Uranus. Occasionally this remote planet is glimpsed by a keen eye but more often it can be identified only with the help of opera glasses or the telescope. The first step is to find its approximate place, which is given in the Nautical Almanac or Ephemeris, and then consult a star atlas in order to see what stars are in its vicinity. When the telescope is pointed in the right direction the planet will appear in the field as a sixth-magnitude star. How then are we to know that this is Uranus? Let us make a map of the region showing the comparative brightness of the stars as well as their relative positions and then compare this map with a large chart containing sixth-magnitude stars. If there is a star in our diagram which cannot be found on the chart it becomes at once a suspicious object, especially if it was seen to have a greenish hue, but we cannot be sure that we have discovered a planet until a

second observation confirms our conclusion by showing that it is moving among the stars.

In many ways these observations of the planets confirm or supplement our previous knowledge concerning them. For, although their markings are not revealed by low powers, yet disks of varying sizes are visible, some noticeably flattened at the poles, an evidence of rotation upon an axis, others presenting phases which depend on their position with reference to the sun. We also view with our own eyes the most characteristic features of each planet, as Jupiter's satellites, Saturn's rings, and the greenish hue of Uranus, becoming familiar with the difficulties and problems attending these observations especially in the case of Venus, Mercury, and Mars, the same difficulties which, though considerably lessened, still persist in the use of larger and better instruments.

If we wish to go beyond the solar system out into the region of the stars and nebulae, we shall still find our little telescope a helpful companion. It is no longer necessary to wait for favorable times for observation as in the case of the planets and the moon, for on any clear night there are plenty of clusters, double stars, and nebulae above the horizon inviting our curious gaze.

Next to the moon some of the star clusters are perhaps the best objects for "showing off" the optical properties of a small telescope. Often when it is directed toward a portion of the sky apparently barren and lacking in interest a glance into the eyepiece will draw forth an exclamation of surprise, for the field of view may be brilliantly adorned with glittering points of light arranged in most interesting configurations. Here it is plainly seen that the chief advantage of a telescope is not its magnifying power, but rather that the objective collects the light rays and concentrates them at a focus so that a brighter image of a faint object is formed than by the unaided eye. No matter how great the magnifying power of a telescope the stars appear as points of light but their brightness is increased in direct proportion to the square of the diameter of the objective. A one and one-half inch lens collects, therefore, about eleven times more light than the naked eye, and an eyepiece which magnifies about twenty times can be used with it. This means that only a part of the Pleiades cluster can be viewed at one time, but by moving the telescope slightly, more stars are found around the edges of the field of view, so that the general effect of the group is not lost, and the familiar stars may be easily recognized among a host of seemingly new companions. While the telescope is directed toward the Pleiades, we must not let the three components of Alcyone escape notice. Having once beheld the tiny equilateral triangle which they form one cannot fail to be delighted at the discovery, and to be eager

to examine other apparently single stars with increased diligence. A list of many interesting doubles, triples, star clusters, etc., which are best adapted for low powers may be had, together with valuable comments about them, by reference to the observer's catalogue in McKready's Star Book.

Variable stars are also of great interest to the amateur astronomer, for even with a small telescope regular and systematic observations of these objects may prove valuable.

A very different object for the telescope is to be found in the nebulae. These are so faint that they require the light-gathering power of the largest lenses to bring out their beauty and reveal the characteristics of the different kinds, classified into gaseous, spiral, planetary, etc. The great nebula of Orion, an example of the first class, is a most interesting object, however, even under low powers and if the observer is desirous of more difficult fields to conquer, let him test his patience and skill upon some of the faint wisps of light with which the sky is richly ornamented.

In the fall of 1914 appeared a comet which was visible to the naked eye, but not conspicuous. I lost no time in seizing the opportunity to add to my telescopic observations. One morning between 2:30 and 3:30 o'clock, I saw in the neighborhood of the pointers of the Dipper an unfamiliar object. It appeared like a rather hazy star of about the same magnitude as α and β Ursae Majoris, but even with the unaided eye I could discern a tail which projected straight up from the horizon. The opera glasses showed it very plainly and my telescope removed the slightest shadow of doubt. It was a comet! There was a bright star-like head surrounded by a luminous cloud-like appearance which merged into the tail. This was broad even close to the head and diverged rapidly, diminishing in brightness so gradually that I could not mark its extremity, but noticed that it was too long to be wholly contained in the field of view. All that I had previously learned as to the nature of comets I recalled vividly at this time and in succeeding observations. Once I noticed a star shining with apparently undiminished light through the comet's tail. Later the comet came to be favorably situated in the evening, but it grew rapidly fainter and was soon lost in the twilight.

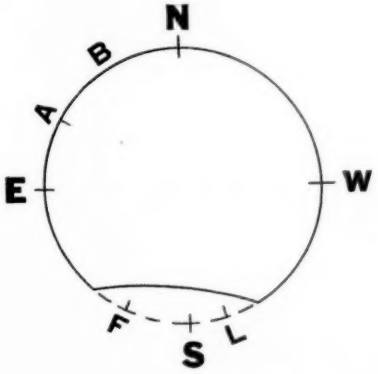
Although comets bright enough to be interesting in a one and one-half inch telescope are rather infrequent visitors, all the other observations described above furnish typical illustrations, but in no sense a complete review of the possibilities open to the owner of such an instrument. Any careful observation faithfully recorded in a notebook according to established rules is well worth one's time and trouble. Those who are interested in astronomy as a pastime, though they do

not pretend to do the work of professionals in this field, should not forget that there is still a great deal which they can do to assist in the vast undertaking in which so many observers have shared—to give the inhabitants of this little world more knowledge concerning their celestial neighbors. Even here the modest home-made telescope may play an important part.

PARTIAL ECLIPSE OF THE MOON 1918 JUNE 24.

WILLIAM F. RIGGE.

On the morning of June 24 there will be a partial eclipse of the moon visible more or less completely in the United States. The magnitude will be 0.135, that is, about 13 percent only of the Moon's diameter will be obscured. The annexed sketch shows the appearance of the moon when the eclipse is a maximum. This will occur at 5:28.



Summer Central Time. N. S. E. W. are the cardinal points of the moon's disk, the point N being nearest the pole star, while some point between A and B will be uppermost for observers in the United States. F is the point of First Contact of the Moon with the Earth's shadow, at 4:46, and L that of Last Contact at 6:10, so that the eclipse will last 1 hour 24 minutes. The visibility of the moon in various parts of the United States may be gauged somewhat by the fact that at Omaha the Moon sets that morning at 5:59 and the sun rises at 5:54.

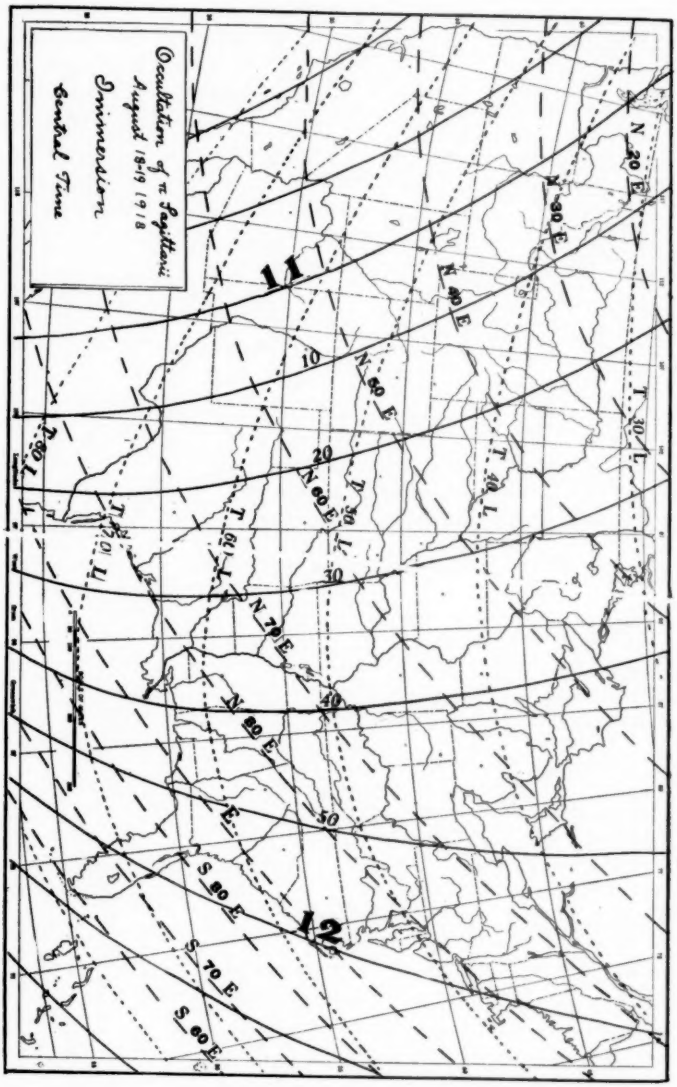
THE OCCULTATION OF π SAGITTARII ON AUGUST 18-19, 1918 AS VISIBLE IN THE UNITED STATES.

WILLIAM F. RIGGE.

Occultations of planets and of bright stars have been very rare of late in the United States. The last occultation of a planet was that of Saturn in the early morning of August 25, 1916, which was visible only to the eastern half of the country. Before that we had two very unfavorable occultations of Venus, both scarcely observable because they occurred in the daytime, one in the afternoon of September 27, 1913, and the other about noon on April 15, 1912. There were also two occultations of Mars on the 1st and 28th of January 1912, each visible to about one-third of the states, the first in the early morning and the second in the early evening. And the last first-magnitude star, whose occultation was generally visible all over the United States at a convenient hour in the evening, was Antares on June 26, 1912.

On account of this great dearth of occultations of bright stars and planets, amateurs and students of astronomy may be interested in the occultation of π Sagittarii on August 18-19, for which the annexed maps have been drawn. Although the star is only of the 3.0 magnitude, it is the brightest object to be occulted until the end of next year, that is, as far as the available editions of the American Ephemeris go. But the occultation will be completely visible all over the United States. The hours, however, are rather late in the east according to our present Summer Time, the immersion beginning in California at about 8:40 p. m., and in Florida about 1 a. m., and the emersion in Washington at about 9:40 p. m., and in New Jersey at about 2 a. m., at their respective standard times. The moon also will be rather bright, about 12 days old, but this will present little difficulty in the telescope.

The first of the two maps is drawn for the immersion and the second for the emersion. In both the full lines give for every ten minutes the Summer Central time, which is five hours slow of Greenwich local mean time, the large numbers 11, 12, 1, being the full hours. The broken or dashed lines marked from N 20 E to S 60 E and from N 50 W to S 20 W, give the position angles of the star on the Moon's limb as counted from its north and south points, and the dotted lines marked from T 30 L to T 80 L and from T 40 R to B 20 L, give the position angles as measured from the top T or bottom B of the Moon's disk


Occultation of π Sagittarii
August 18-19 1918
Immersion
Central Time
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T 50 L
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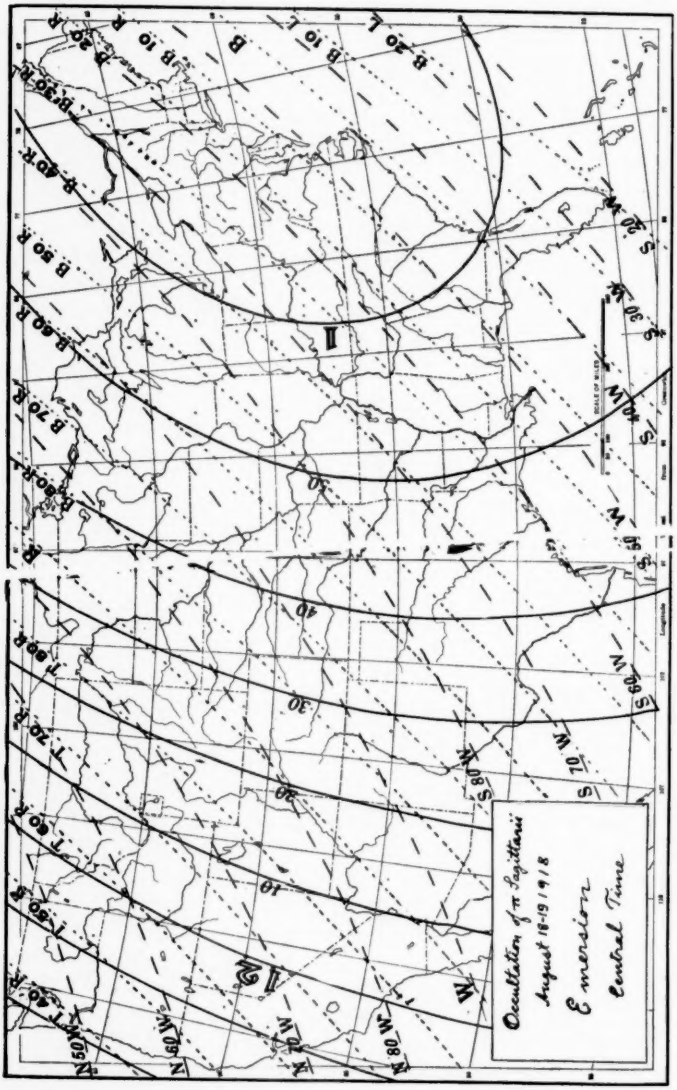
T 70 L
T 80 L


Occultation of π Sagittarii
August 18-19 1918
Emersion
Central Time
Latitude
Longitude
SCALE OF MILES

towards the right R or left L. Along and within the 1 a. m. oval on the emersion map, the moon will be very low in the sky, the Last Contact for the earth generally, that is, the very last place to see the emersion, at 1:09, being situated in latitude +41° and in longitude +63°, just off the map.

One interesting feature is shown in these maps, and this is that the Moon in a way measures its size with the United States. As the time curves show the edge of the Moon's cylindrical stellar shadow at the given moments, we see that the Moon's preceding limb will reach the eastern shore of the United States at the immersion at 12 o'clock midnight at the same time that its following limb will have crossed the western shore at emersion. These two 12 o'clock curves when placed on the same map give a true outline of the Moon's shadow. The diameter of the Moon 2163 miles is shown in a way by the distance of the E point at immersion at Cape Hatteras from its W point at emersion in the Pacific Ocean near Southern California, or by any other two diametrically opposite points on the Moon's limb at the same time. Of course, strictly speaking, this lunar diameter is projected on what is called the fundamental plane, that is, the plane at right angles to the star's rays, so that on account of the curvature of the earth's surface and its inclination to these rays, the two places are really farther apart than 2163 miles.

THE GREAT AURORA OF 1918 MARCH 7.

E. E. BARNARD.

The aurora of March 7 last was one of the finest that have been seen here, and for the display of color it was the finest of all our large auroras. The want of color in essentially all of our auroras has always been a very marked feature. This has been a surprise to me, for I still have vivid recollections of the beautiful colors, especially crimson, that were shown in the great aurora of April 16, 1882, which was seen at Nashville, Tennessee, latitude +36° 9′. Compared with that one all the auroras seen here previously have been woefully lacking in color. But the present aurora made up in some ways for this want—especially in the brilliant crimson of certain of the streamers.

The afternoon of March 7 was threatening and gloomy and the prospect of a clear night seemed hopeless. In the late afternoon, however, the clouds drew away in a broad sheet to the south, like a great curtain, leaving a beautifully clear sky, as if preparing the stage for one of Nature's noblest and sublimest plays—the play of a great aurora.

The aurora seemed to be in progress at dark. I first saw it at $7^h\ 15^m$ C. S. T. At this time all the northern sky—nearly as far as the zenith—was blotted out with a brilliant yellow auroral light, so dense that it hid all the stars in that direction. This was definitely bordered at its upper, advancing edge with a great band of whiter light, which was preceded by still another arch rising toward the zenith like the advancing edge of a great storm. At this time Mars was shining in the east through a greenish-blue haze, which, by contrast, made the planet look intensely fiery red. I think this haze of light coming up from the north was the densest and strongest I have ever seen in an aurora. It was tinged with much red, and especially with yellow.

The most striking feature and the most beautiful of the display on this date was the persistence and regularity with which a crimson streamer would make its appearance in the low northwest and shoot upwards for a great distance. Its base was near the horizon about 20° north of west. The streamer was inclined some 30° towards the south. It would suddenly shoot up, sharp and distinct, to a great height and of an intense crimson color. It would then diffuse into a red glow over a large area. This glow would hardly fade out before the streamer would once more appear, only to diffuse again into a dull red glow. This streamer repeated itself at intervals of about five or ten minutes for upwards of three hours. It seemed to be working independent of the rest of the display, as if two systems of auroras were in progress at the same time. Most of the time there was (especially to the left of it) a background of greenish blue against which the crimson streamer was projected with wonderful effect, the contrast of color being almost startling. At intervals, though not so often, a similar crimson streamer appeared in the east. At one time a crimson arch formed above Polaris, and extended from the east to the west. Once the streamer in the northwest formed a sheaf of crimson rays some 30° wide, which was strikingly beautiful.

A marked feature of the display up to $9^h\ 45^m$ C.S.T. was the entire absence of the rapidly ascending light waves or pulsations which seem to be a function of the large auroras seen here. They began about the above time and were active till long after midnight (as late as 14^h)—perhaps throughout the rest of the display. They seemed to rise vertically from the horizon, following each other with great rapidity. Momentarily they strongly illuminated masses and rays in their ascent.

Some of these masses were not visible except when illuminated by these passing waves, though they were seen to be persistent for some time and rather slowly changing their forms.

Several times before midnight a distinct central point of convergence appeared south of the zenith, from which rays of light descended in all directions—south as well as north—like the ribs of an umbrella. Twice this point was located with respect to the stars:

$9^h\ 47^m$ C. S. T. 1918.0 R. A. $8^h\ 45^m$, Decl. $+\ 24°$
$10^h\ 23^m$ C. S. T. " R. A. $9^h\ 2^m$, Decl. $+\ 27°$

The first position is the more accurate. It will be noticed that this point was apparently advancing towards the east and the north and therefore not fixed with reference to the observer's position. At no time did it remain visible more than a few minutes. It would disappear and then form again. When visible it was seen that the rapidly ascending light waves or pulsations culminated at this point, illuminating and brightening successively the rays and masses that they passed in their more or less vertical flight to the central point.

Between $7^h\ 30^m$ and $8^h\ 0^m$ it was recorded that the ground was grayish white from the reflection of the intense auroral light overhead. It was reported that sometimes masses of snow appeared red from the reflection of the crimson streamers.

At $8^h\ 20^m$ the dense light overhead had spread and covered much of the southern sky. It was specially heavy over Orion. There were bright strips of this nearly to the southern horizon. At about $8^h\ 30^m$ and $9^h\ 0^m$ there were several bright clouds south of Sirius and Orion, which were slowly drifting south and remained visible for some time.

At times the sky was unequally covered with streaky luminous haze closely resembling but brighter than the luminous night haze sometimes seen here when no aurora was present. Beautiful curtain effects were formed several times by the bases of streamers. These were bluish or greenish in color. They were specially beautiful about $8^h\ 20^m$ and at $9^h\ 47^m$, when the bases of the streamers near the northern horizon were like irregular folds in a curtain. At $10^h\ 2^m$ and $10^h\ 9^m$ splendid bluish green curtains covered most of the northern sky.

The aurora seemed to attain its maximum before midnight, though it was still active as late as 14 hours.

Yerkes Observatory,
Williams Bay, Wisconsin.
1918 April 26.

A NEW STELLAR PHOTOMETER.

MENTORE MAGGINI.

Professor Parkhurst in the *Astrophysical Journal** has described a photometer designed by Pickering for the study of variable stars. During my observations of variables in monochromatic light† I was led to the construction of a similar instrument. The Algol results are the object of the present note.

The Photometer.

The general form of the photometer is similar to that of the Wedge Photometer described by Parkhurst. The ocular tube AA is divided in

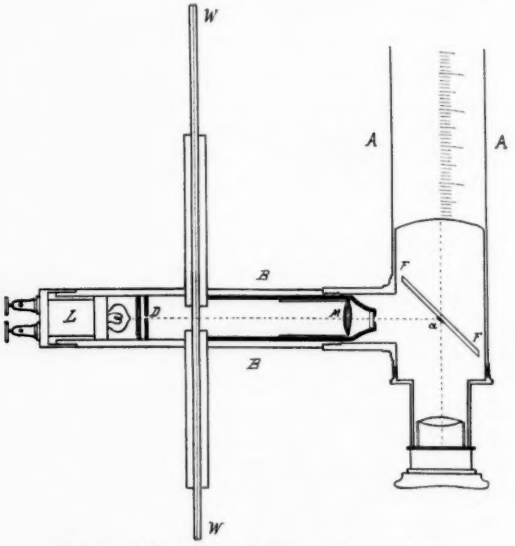


Fig. 1. A New Form of Stellar Photometer.

millimeters for the estimation of extra focal distances. At right angles is placed the tube B, which contains the incandescent lamp L. The

* *Determination of the wedge constant of a stellar photometer. Astroph. Journ.* Vol XIII, p. 249.

† *Memorie degli Spettroscopisti Italiani*, Vol. III; ser. 2ª, p. 149; *Bulletin de la Società Astronomique de France.* Avril 1915.

light of this lamp passes through the small circular diaphragm D, then the lens M projects an image of the aperture upon plate F of plane parallel glass, placed at an angle of 45° in the interior of ocular tube. At the precise point where the image of the diaphragm is formed the plate has a small silvered surface α*. This mirror is projected upon the extra-focal image of the star and its brightness changed until it vanishes. The change in intensity of the light can be produced by different arrangements: by changing electrical resistance with a rheostat, or by the use of an absorbing wedge. I have adopted a photographic wedge.

The process of determining the magnitude difference Δm of two stars s, s_1 is as follows:

The ocular is placed at distance d from the focus, the small mirror α is projected upon the disk of the star s and its brightness changed by the wedge until α vanishes. Then α is projected upon the disk image of s_1 and the ocular tube is moved until α vanishes anew.

Let d_1 be this last distance from the focus, i and i_1 the brightness of two stars; we have then

$$\frac{i}{i_1} = \frac{d_1^2}{d^2}. \qquad (1)$$

The difference in magnitude Δm is, by Pogson's rule,

$$2.512^{\Delta m} = \frac{d_1^2}{d^2}. \qquad (2)$$

Then

$$\Delta m \log 2.512 = \log \left(\frac{d_1^2}{d^2} \right),$$

$$\Delta m = 5 (\log d_1 - \log d). \qquad (3)$$

The diameter of surface α adopted by me is ⅓ of millimeter†; the instrument used is a 122 mm refractor, the angular diameter of α is therefore about 30″. I have assumed the distance d equal to 30 mm; then extra focal images of the stars are large, 1′ in diameter.

An investigation of the precision of the measures furnished by this photometer was made assuming $d = 30$ mm, and equation (3) was computed with values of Δm differing by $0^m.1$ in succession. The values of the difference of ocular distance $d_1 - d$ and those of Δm were

* In all cases I have taken for the measure of the surface α, the small disk determined upon plate F by the image of the diaphragm.

† This is obtained by drawing a small circle upon the silvered surface of the plate with a magnifying glass and needle, removing the superfluous silver by means of a grinding stick dipped in hydrochloric acid.

plotted with $d_1 - d$ as abscissa and Δm as ordinate, and the resulting curve gives directly for the observed $d_1 - d$ the equivalent Δm. The mean Δm for 1 mm movement of the eyepiece diminishes as the distance d_1 increases. In fact for $d = 30$ we have:

$(d_1 - d)$	10^{mm}	20	30	40	50	60	70	80
Δm for 1mm	$0^m.064$	.056	.051	.046	.043	.040	.037	.036

An inspection of the above values shows that the maximum Δm per millimeter is only a little over $0^m.05$; this value is smaller than that generally called "wedge constant" in the common *wedge photometer.* This is an advantage of our photometer.

I have said that the variations of brightness are obtained by using a photographic wedge. Now it is evident that the manner of changing the light with the wedge does not enter into equation (3), therefore it is not necessary to know the value of a millimeter of range, nor this value constant throughout the entire length of the wedge. This is is a great advantage, because the method of preparing a photographic wedge is somewhat complicated*.

Two defects of this photometer are: the loss of light in the extra-focal images, the color of the artificial light. This last difficulty is removed by interposing various colored glass, blue or yellow, between the lamp or the lens M and the small mirror.

Monochromatic Observations of Algol.

Determination of the monochromatic light curve of Algol was made in 1908 by Nordmann† using his "Photometre stellaire étérocrome" which is a modification of the Zöllner photometer.

I have transformed my photometer into an "eterochrom" by the substitution of a plate of colored glass for the plate F. Two glasses are used, first red, second, blue-violet. The mean wavelength of the light passing through the glass is

Glass 1 $\lambda = 645\ \mu\mu$,
" 2 $\lambda = 412\ \mu\mu$.

The two glasses are easily changed in the ocular tube. The power used in these observations is 70; the incandescent lamp is an "Osram 3.5 volts." The observations were made on very transparent nights of Sept.-Dec. 1917, the comparison stars being as follows:

$*_1 = \alpha$ Persei $1^m.90$ Sp. F5 (Rev. Harv. Phot.)
$*_2 = \lambda$ Persei 4 .33 " A0 "

* *Annals of the Harvard College Observatory*, Vol. 41, p. 237, Vol. 59, p. 36 and 95.

† *Bulletin Astronomique*, Vol. XXVI, Janv. 1909. *Comptes Rendus*, Vol. 149, 150, 151.

Since these magnitudes were determined in the natural light of the stars, I have redetermined them in the light λ645 and λ412. Therefore I have adopted for $*_2 = \lambda$ Persei the magnitude in λ645 and λ412 equal that in natural light, $4^m.33$; then I have determined with the photometer the value of the difference $*_2 - *_1$, in λ645 and λ412. The means of 18 measures in λ645 and 25 in λ412 are as follows:

$$(*_2 - *_1)645 = +\,3^m.25 \qquad (*_2 - *_1)412 = +\,1^m.95$$

Then the magnitude of $*_1 = \alpha$ Persei are:

$$(*_1)645 = 1^m.08. \qquad (*_1)412 = 2^m.38$$

Comparison of the variable with $*_1$ and $*_2$ was made according to the following scheme. The ocular tube is placed at the distance 30 mm from the focus and three comparisons $*_1\, v\, *_2$ are made, then three $*_2\, v\, *_1$. Every night the measure in λ645 were alternated with the measure in λ412; a complete measurement in two radiations requires about ten minutes.

Since the comparisons were made without regard to the phase of the variable, it follows that the observations are distributed over all phases of the light change. The observations of the minimum permit the study of the change of light in two radiations. The light curves are shown in Figure 2; their coördinates are given in the following table:

No.	Δt	Mag. λ645	Mag. λ412	No.	Δt	Mag. λ645	Mag. λ412
	h m	M	M		h m	M	M
1	−4 45	2.26	2.35	21	+0 15	3.34	3.65
2	4 30	2.28	2.36	22	0 30	3 28	3.62
3	4 15	2.32	2.41	23	0 45	3.20	3.56
4	4 0	2.37	2.47	24	1 0	3.13	3.49
5	3 45	2.43	2.55	25	1 15	3.05	3.41
6	3 30	2.48	2.62	26	1 30	2.99	3.34
7	3 15	2.54	2.70	27	1 45	2.92	3.26
8	3 0	2.61	2.78	28	2 0	2.85	3.18
9	2 45	2.67	2 85	29	2 15	2.78	3.09
10	2 30	2.75	2.93	30	2 30	2.72	2.96
11	2 15	2.81	3.01	31	2 45	2.65	2.92
12	2 0	2.88	3.09	32	3 0	2.59	2.83
13	1 45	2.96	3.16	33	3 15	2.53	2.75
14	1 30	3.03	3.25	34	3 30	2.47	2.66
15	1 15	3.11	3.33	35	3 45	2.42	2.58
16	1 0	3.19	3.45	36	4 0	2.37	2.50
17	0 45	3.27	3.47	37	4 15	2.32	2.45
18	0 30	3.35	3.54	38	4 30	2.29	2.38
19	−0 15	3.41	3.60	39	4 45	2.26	2.36
20	0 0	3.40	3.64	40	+5 0	2.26	2.36

Figure 2 shows that the light change begins and finishes at about the same epoch for two radiations. The brightness in λ645 remains superior to that in λ412. The epochs of two minima are not coincident: minimum in λ645 precedes the λ412 minimum by 17^m, this is in agreement with

Nordmann's results, for which there was a difference of 13^m in the $\lambda 680$ and $\lambda 450$ minima.

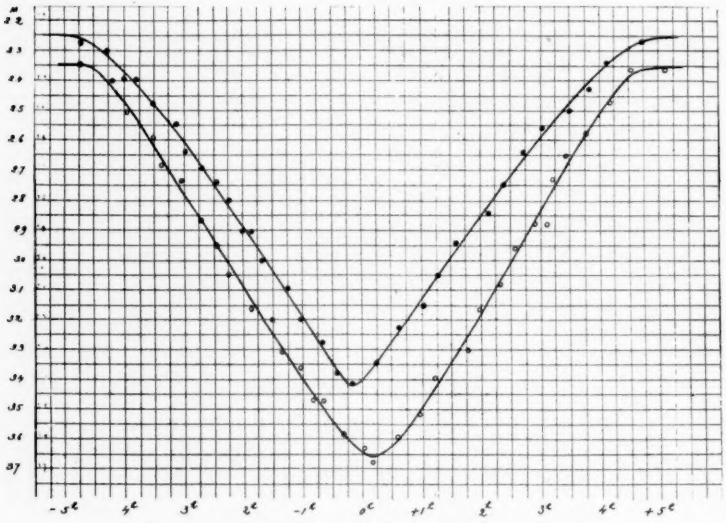


FIG. 2. LIGHT CURVES OF ALGOL AT PRIMARY MINIMUM, IN WAVELENGTHS $\lambda 645$ and $\lambda 412$.

In Figure 3 I have placed the curve relating to the observations made during the constant light. The points obtained for this curve are means of groups of three observations. The secondary minimum of Algol is evident in the radiations $\lambda 645$ and $\lambda 412$, very manifest

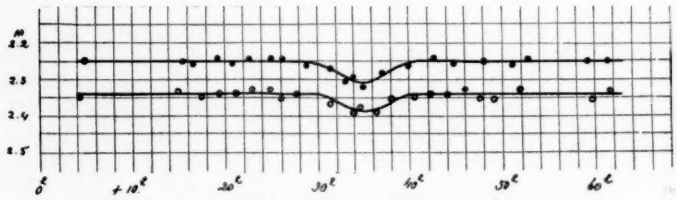


FIG. 3. LIGHT CURVES OF ALGOL AT SECONDARY MINIMUM.

in $\lambda 645$. At the phase $+35^h$ the light in $\lambda 645$ is diminished in brightness about $0^m.06$, the light in $\lambda 412$ about $0^m.04$; these values are greater than the probable error of an observation.

The results obtained are tabulated below.

	λ645	λ412
Duration of light change	9^h 45^m	9^h 15^m
Constant light	2^m.250	2^m.340
Principal minimum	3 .423	3 .655
Secondary minimum	2 .308	2 .380

Florence, Italy.
January 1918.

SILVERING OF TELESCOPIC MIRRORS.

[M. G. Raymond in L'Astronomie for October, 1917; Translated by Charles Nevers Holmes.]

"Telescopes with mirrors of silvered glass reflect as much as 95 percent of the incident light when they are in good condition; that is to say, with equal surface they return to the eye a little more light than the best object-glasses, in which the loss, due to absorptions and especially to reflections on their surfaces, can reach 20 percent.

"The product of modern reflecting telescopes is therefore equal to that of the refractors; their advantage is considerable from the photographic view point, being exempt from chromatic aberrations; besides, with equal power, they are more easy to handle, being less bulky; their price is much more accessible; all of which are reasons which should assist in their distribution among admirers of the beauties of the sky.

"We shall not examine here the different processes of silvering, contenting ourselves with describing only one, which gives excellent results, viz., that of Brashear.

"The preparation of the surfaces for silvering plays a considerable rôle in the success of the operation. The mirror should be cleaned with a wad of cotton-wool soaked in nitric acid, then washed with plenty of water; in order to get rid of the traces of oily matter, it is treated further with the cotton-wool soaked in an alkaline solution; fresh washing followed by a second treatment with nitric acid; the mirror is washed with *distilled water* and placed face downward in a pan containing this last liquid, where it is left until its immersion in the bath of silver.

"In order to prepare this last, it is necessary to have *pure* chemicals. The following are the solutions and necessary ingredients.

"I. Reducing solution:

Distilled water	1,000 ccm.
Ordinary sugar	90 gr.
Nitric acid	5 ccm.
Alcohol at 90%	175 ccm.

"The alcohol has for its purpose only to prevent the subsequent fermentation. This solution is good only at the end of eight days; it improves with time.

"II. Solution of nitrate of silver of 1 percent in distilled water.

"III. Solution of pure caustic potash, of 1 percent in distilled water.

"IV. A flask of pure ammonia.

"The reaction is based on the reduction, by the inverted sugar, of the oxide of silver dissolved in the ammonia.

"A well-made bath of silver should always contain 1 gramme of nitrate of silver and a half-gramme of caustic potash.

"To prepare the bath of silver, take 100 ccm of the solution of silver No. II; add to it, drop by drop, some ammonia *with extreme caution*; there is produced a brown flaky precipitate of silver oxide which redissolves very quickly in an excess of ammonia. *It is necessary to avoid the bath's becoming entirely clear*; it should remain slightly brownish. The success of the silvering depends much upon the preceding operation; *one has always the tendency to add too much ammonia.*

"The preceding solution being in the condition which we describe, there is added 50 ccm of the 1 percent solution of potash, No. III. There results a muddy precipitate, the color of coffee and milk.

"This precipitate is redissolved with some drops of ammonia, *always with extreme caution*; it is a good plan, before adding this alkali, to reserve half of the muddy bath, so as to add it, little by little, and to *preserve in the liquid a light brown color.*

"This liquid is poured into the dish or pan which is to receive the mirror and, in order to reduce the silver oxide which it contains, there are added *six* cubic centimeters of the reducing solution No. I, at the same time stirring the mixture rapidly. The mirror is immersed in it (taken out of its bath of distilled water), *face-downward*, and separated from the bottom of the pan by three glass props, avoiding with care bubbles of air; for that reason, the mirror is put into the bath by its edge and it is laid obliquely in the pan in order that it may rest on the props, designed to allow the liquid to circulate under all the immersed surface, at the same time moving the pan with a light rocking motion.

"It should be understood that, with mirrors of different sizes, it is necessary to take quantities proportional to those we have described.

"The reducing solution being poured out, the liquid begins to blacken and to become muddy, the silver depositing itself in the form of a bluish purple layer, which proceeds to thicken. This first layer is *fragile and very thin*; the mirror is withdrawn from the exhausted bath, is immersed in the pan containing distilled water during the time that a *second bath* of silver is being prepared, the same as the first bath. The

second layer is sufficient; it is somewhat dim, yellowish and opalescent. The mirror is rinsed with distilled water, then freely under a tap of ordinary water, and is left to dry on edge. The temperature of the baths should be near 18° C. At this temperature *the layer of silver is hard and takes on a very beautiful polish*; at a lower temperature a very poor deposit is made; above 20°, the deposit is rapid but has no consistency.

"*The mirror being perfectly dry*, the layer of silver is polished with a wad of cotton-wool dipped in *polishing rouge*, rubbing delicately until the polish is perfect. The same operation is done thoroughly with chamois skin (*new and very clean*) dipped with the rouge mentioned above. A good silvering may last many years. When the mirrors are a little tarnished and dim, they can be revivified by a new polishing.

Newton, Mass.
41 Arlington, St.

THE BRIGHTEST STARS OF THE SOUTHERN HEMISPHERE.

ISOLINA V. MILLÁS.

The southern hemisphere offers, when compared with the northern, a wider field of work to all lovers of astronomy, for it has been less studied notwithstanding the fact that it possesses the two brightest stars in the sky, the most beautiful coloured star-cluster, the largest globular cluster, the brightest double star, the nearest of the stars, and the most beautiful part of the Milky Way.

In the southern hemisphere shines Sirius, the brightest star of all the sky; flashing and scintillating it glows as a mighty diamond of the winter nights. Sirius' light is greenish-white, and it is most interesting to note that ancient authors speak of Sirius as a red star; yet it is very difficult to admit that this star has changed from a red to a white one, and it seems highly probable that it has all been a mistake, based upon a wrong translation of the astronomical poem of Aratus, made by Cicero. To the ancient Egyptians it was the Nile-Star, the star of good cheer, for when it was seen just before sunrise the coming of the floods could be hoped and looked for, and as these floods meant life itself to the Egyptians it is easily understood why they should have even worshipped the beautiful Nile-Star, and that their year should begin the first day on which Sirius rose just before the sun.

Sirius is not only a beautiful star, but a very interesting one also; Bessel, following the oscillating movement with which Sirius travelled through space founded "the astronomy of the invisible"; that is, to the appalling number of visible suns of the universe, he showed the possible existence of a number so vast, that the human imagination would be lost in a powerless effort to grasp an extension far beyond the limits of mortal comprehension. It was in 1844 that Bessel pointed to the possibility of the oscillating movement of Sirius being caused by a dark, invisible companion; just a few years later, Mr. Alvan Clark, wishing to test a large lens, turned it on Sirius and found the companion, shining with a light so feeble that only through the influence it had on Sirius could the existence of the dim sun have ever been suspected. This excessive faintness compared with its size, larger probably than our sun, has lead many to think that it shines by reflected light from Sirius, which would of course mean that the dim companion was not a sun but a planet, a planet so vast that the mere thought of its immensity, being equal to more than a million earth's, made many reject the possibility, and prefer to think of Sirius' companion as a sun whose condition is very different from that of other suns. Just as this satellite is remarkably faint in comparison with its bulk, Sirius is wonderfully brilliant; its light is estimated at 30 times that of the sun and were the earth a planet belonging to the system of Sirius, it would have to be removed to a distance of nearly 500,000,000 miles, to receive the same amount of heat and light which it now has. The distance of Sirius has been quite accurately determined in recent years and is generally accepted to be 51,000,000,000,000 miles. This distant sun stands in a class all its own, for it has no equal in all the sky.

Next to Sirius in brightness shines Canopus, the rudder of the ship Argo, in which Jason sailed in search of the Golden Fleece. Canopus' brilliancy is equal to that of possibly 40,000 suns like ours, and its distance is so remote that it is beyond measurement; the failure to detect any parallactic shifting in Canopus makes it necessary to believe that its light travels over 400 years before reaching us. It is a star of the same type as Procyon, which means that its mass is surprisingly small in proportion to its light. Canopus is receding from us at the rate of 12 miles a second. Canopus is the star Alpha of the large constellation Argo Navis, beautifully seen in our latitudes.

Vega, Capella and Arcturus are the brightest stars of the Northern Hemisphere, but Sirius, Canopus and Alpha Centauri fairly outshine them, brilliantly gleaming in the Southern Hemisphere. Alpha Centauri is excelled in brightness by Sirius and Canopus, but this makes it none the less interesting. Alpha Centauri is our nearest neighbor among all the host of stars, being at a distance of only 4.3 light years. It is one

of the two first magnitude stars of Centaurus, the brilliant constellation well seen only from latitudes near the equator or south of it. Alpha Centauri is a very beautiful double star; for Herschel it was a "superb double, beyond all comparison the most striking object of the kind in all the heavens." He has also mentioned something about their color, "both of a light ruddy or orange color, though that of the smaller is of a somewhat more somber and brownish cast." It is the larger of the two that it is so surprisingly like our sun in size and in constitution. This interesting pair is approaching us at a velocity of 13.7 miles a second; their proper motion is 3″.66.

The Centaur has another pointer to the Cross, the famous constellation of the Southern hemisphere; this is the star Beta, also a first magnitude star but not as bright as Alpha, and belonging to another class; just as Alpha is a star of the solar type, Beta is one of the Orion stars, shining with a bluish white light, a light almost in its native state. These stars, known as Orion or Helium stars, are said to occupy an intermediate place between Nebulae and Sirian stars, among which they formerly classified. Beta Centauri is at a distance of 88 light-years and has a proper motion of 0″.04.

Another of the most interesting stars of the Southern Hemisphere is Beta Orionis, the giant's foot; the brightest star of this class and of exceeding beauty. Notwithstanding its brilliancy, it is very remote from us, being at a light-distance of at least 450 years, a distance that is increasing at the rate of 39 miles a second. Rigel shining with a bluish-white light holds the promise of youth, and the enchantment of a sun whose course has just begun. Rigel is one of those stars that have made it necessary to divide Father Secchi's first type of stars, that is, to consider in the order of development, first the stars of the Orion quality, and then the Sirian stars, the Orion occupying a position intermediate between the latter and true Nebulae. Of course there are degrees of development even among the Orion stars; Rigel gives evidence of a development superior to that of Theta Orionis, at the core of the great nebula, for Beta Orionis is already tending toward the Sirian group of stars. Rigel is a very beautiful double; if it were not for the brilliancy of the larger component, Rigel's little blue companion would be seen with a very small telescope; for some observers, Rigel as a double is of exceeding beauty.

Starting at Rigel a long stream of faint stars flows westward and southward with Achernar, the Last-of-the-River, as the only beautiful object which it can claim; it is like Rigel, an Orion star, 64 light-years distant from us.

In the small and beautiful constellation, known as the Cross, near the south celestial pole, shines Alpha, its only star of first magnitude; it

marks the foot of the Cross and is within 27 degrees of the south pole. This bright star, considered as almost of standard first magnitude brightness, was found to be composed of two stars, very brilliant and nearly equal, of 1.6 and 2.0 magnitude, about 5″ apart. Owing to the fact that since their positions were determined, in the beginning of the nineteenth century, they have not perceptibly changed, their small proper motion is supposed to be identical. Alpha Crucis has another small star of the seventh magnitude, 90″ to the southwest, seen only in a large telescope because of the brilliancy of the pair. Alpha Crucis is not only a beautiful star, but it is wonderfully situated in the midst of a symmetrical group of very faint stars which seem to form a corona for the lovely star that marks the foot of the famous Cross of the Southern Hemisphere.

During the early evenings of autumn, Fomalhaut is seen as a lovely star in the southern sky; it is the only object of real interest and beauty to be found in the constellation to which it belongs, Piscis Australis. Fomalhaut is supposed to mark the Fish's mouth; it is a very brilliant star of the Sirian type, and its distance is twenty-four light-years. Fomalhaut is not accepted as a double bya ll astronomers; it has a distant companion of a dull blue, difficult to see; difference in R. A. 4.8 sec. Fomalhaut shines with a slight reddish tint. It has always been important as a "nautical" star and as such its position was carefully computed long ago.

In Virgo, a large constellation lying in the track of the planets, shines the beautiful white star Spica, the Ear of Corn, supposed to be in the Virgin's hand, and undoubtedly one of the finest "land marks" of the southern sky. Spica is immeasurably far from us and to account for the intensity of its light it has been estimated to be more than 1000 times more luminous than our sun. Spica is a spectroscopic binary; the spectroscope gives two spectra, one bright, the other faint, the lines in which draw apart and come together again once every four days, which shows that these stars are close together; the mass of the pair is stated to be two and one-half times that of the sun. Like so many other bright white stars, Spica has a small blue neighbor visible by means of the telescope. Spica was the first non-eclipsing star recognized as a double by the movement of lines, and it was also Spica that lead Hipparchus to the discovery that all stars changed their apparent positions; slowly but inevitably the stars complete a cycle in almost 26,000 years, which means that to see a star in the same place, 240 centuries must pass on. Hipparchus was led to this discovery by the different position given to Spica by another Greek astronomer who lived a hundred and fifty years before him, and the position he himself had determined.

Antares is an immense red star shining in the heart of the Scorpion. The Greeks gave it this name because they said it rivalled the red planet Mars in color; it was known to the Greeks, the Latins and the Arabs as the Scorpion's Heart. Viewed with a telescope, a little green star is seen apparently touching this fiery star, whose distance from us is so great that the light which leaves it reaches us only after having travelled 112 years; but this beautiful star, one of the finest of the first magnitude, is drawing nearer to us at the rate of about 150 miles a minute. Antares is also a spectroscopic binary; a companion shows its existence through the shifting of lines in the spectrum of this star. Antares has also a small companion that may be seen under good atmospheric conditions with a five or six-inch telescope; it is of the seventh magnitude, 7″ west of this fiery red first magnitude star. As to its constitution, Antares is singularly interesting; it represents the last stage of stellar development; it has lived its life, and though to reach extinction may mean a longer time than the whole duration of the human race, still it is not without awe and regret that one looks upon the life expiring in this giant sun.

Of the twelve constellations that lie along the ecliptic and constitute the Zodiac, Scorpio is the most brilliant, and beyond doubt it is also the most perfect in outline among all the constellations belonging to both northern and southern hemispheres; it is almost impossible not to be impressed with the singularly striking appearance of this gigantic scorpion of the skies; little wonder that fable should have chosen this monster to so terrify Phaeton as he dashed along the zodiac, that he lost control of Apollo's horses and came very near burning up the earth by running the Sun into it.

Havana, Cuba.

THE ANSWER.

It is midnight.
I stand, alone,
On the shore of the Pacific,
Gazing far out into the west.
Above, stars, like fiery eyes,
From a distance flash, and thru
The trackless, intervening void,
Comes an answer, to my unspoken quest.
"Thou art as old as we, as the sky,
Mountain or sea,
Thou, too, art eternal."

SYLVIA CUSHMAN.

20 Winchester St.
Brookline, Mass.

WHAT WAS THE STAR OF BETHLEHEM?

STANSBURY HAGAR.

Concluded from page 332.

But though Aries was the constellation of the shepherds, it was the astronomers themselves who as shepherds watched by night the wanderings of their starry flocks across the fields of the sky. Is there in poetry a more beautiful simile? As one writer states it, "The imagination of the Chaldeao-Babylonians, as of the western Asiatic peoples in general, saw in the stars a vast flock scattered over the celestial spaces and each orb which appeared to lead the course of a cluster of other stars was a lulim or chief, for this expression pertaining to pastoral life finally became a poetic way of designating a chief or king."* So in the early Euphratean astronomy the Milky Way was known as the River of the Shepherd's Hut and the heavens as the Shepherd's Tel or Mound. The shepherd was the sun god Dumuzi, the Son of Life.† The star Arcturus, opposite Aries in the sky, was also known as the Shepherd of the Heavenly Flock, and Orion was the shepherd, "Keeper of the flock of stars," and the "Shepherd Spirit of heaven."‡ Bethlehem itself was a place of pasture where David first sang as he watched his father's sheep. Higgins in his Anakalypsis has shown that in the literature of that period the names of actual places on earth were used of ideal and celestial regions. On the Euphratean stellar tablets the name of the city of Eridu is applied to an asterism.¶ It was customary for the shepherds to keep watches of three hours each by turns to preserve the sheep from beasts of prey and from bandits, and these watches provide another simile for the watches of the astronomers. And so the shepherds of Luke's account are one with the wise men, the Magi, the priest-astronomers of Matthew, who foretold the Nativity by watching the stars. These astronomers were indeed in the old days the leaders, princes, and kings of the people in matters both intellectual and spiritual. The Egyptians called them the mystery teachers of the heavens and in the Book of the Dead, better called the Book of the Master of the Secret House, and

* Cuneiform Inscrip. of West. Asia, Vol. II, pl. 31, l. 41, d. e.

† R. Brown, Jr., The Milky Way in Academy, Vol. 41, p. 43.

‡ Olcott, Star Lore of All Ages, p. 278.

¶ R. Brown, Jr., Euphratean Stellar Researches, p. 24.

other sacred writings, nearly every religious idea was conveyed by some astronomical analogue.*

According to Dupuis the Magi were priests of Zoroaster and worshippers of Mithras, and the gold, frankincense and myrrh which they offered at the Manger were the three materials usually offered to the sun by the Arabs, Chaldeans and other Oriental peoples. In the early art of the Roman catacombs they almost always wear the Mithraic or Phrygian cap. At least the Magi were known as observers of the sun and stars who would be employed appropriately enough in watching for the solstice. And so the stable of birth with the animals around it is the simile of the night sky and of the zodiac, the zone of celestial animals. The "house" mentioned by Matthew is probably the solstice in which the sun rests.

To return to the taxing mentioned by Luke for which Joseph and Mary went up to Bethlehem, it seems that this was an enrolling or noting down of the population rather than an actual taxing. So the astronomers noted down mentally the stars as the luminaries entered within their field of vision and passed on to assume each its proper position in the solstitial heavens. The literal interpreters are again in trouble here, for it has been pointed out that a census would have been impossible in winter, as the whole population could not then have been put in motion, yet only in winter could field labor have been suspended.† Baron von Oefele has shown that a list of the positions of the planets from 17 B. C. to 10 A. D., lately discovered in Egypt, gives a number of details that correspond with those set down in the second chapter of Matthew, also that the Greek word ἔστη translated "stood" in that chapter and referring to the star which "stood over where the young child was" is itself a translation of a technical term used by the Egyptian astronomers to describe one asterism in conjunction with another.‡ More specifically it seems to have been used to represent the position of a planet when its apparent direct motion ceases and its retrograde motion is about to begin or vice versa. The similarity of the position with that of the sun at the solstice is evident, for then the solar southward motion ceases and the northward begins, or the reverse. Moreover the very name solstice refers to the standing of the sun. So though Baron von Oefele thinks that the conjunction referred to was that of the two planets, we may suspect that it was the conjunction of some asterism with the solstitial point on the meridian. If we are right we may

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* W. M. Adams, Book of the Master of the Secret House, p. 22.

† Catholic Encyclopedia, "Christmas."

‡ Mittelungen der Voederasiatischen Gesellschaft. 8 Jahrgang, 2d Pamphlet, pp. 40, 41.

reasonably ask which seems more probable, that this technical, scientific expression was used in a literal account written for the supposedly unscientific early Christians, or that it is evidence of an account written by astronomers for astronomers, as the interpretation in this article implies?

But what then was the Star of Bethlehem? In the light of these facts this star was nothing more than an asterism which annually marked for the astronomers the approach of the solstice. It may have been Praesepe itself, but as that group is inconspicuous and difficult to observe, it seems more probable that it was some bright star near it. If so the star Pollux in the Twins seems best to fulfill the required conditions, because it is the nearest bright star to the solstitial point and is slightly in advance of it in the celestial procession. We have seen this star and Castor used for this very purpose on the Mithraic cameo. Let us note that the star is not mentioned in Luke's account where it would have to follow the shepherds of Aries and the angelic host of Taurus, thus disturbing the sequence of the story. Matthew's account begins with the wise men of Orion under Gemini and in this episode the star first appears in the proper sequence if Pollux is intended. The astronomers watching for the coming of the solstice would first see this star rising "in the East" as did the wise men. They would then search diligently over the celestial fields of Bethlehem for the approach of the celestial Manger to the solstitial meridian. "And, lo, the star, which they had seen in the east, went before them till it came and stood over where the young child was." That is, Pollux moved westward before their watching eyes until it stood upon the meridian overhead and then and there announced the immediate coming of the solstice. This is no supernatural event but a cosmic poem reverently related in simple and unmistakable language, clothed in noble and beautiful imagery and resonant with the eternal harmony of the spheres. Nor should we forget that in this cosmic harmony the sky, the stars and the sun itself sang for those who listened, the motif repeating and repeating that like the sun the human soul journeys across the skies of life to set indeed but only to rise again and again triumphant over darkness and the grave. The astronomic is not the ultimate symbolism of the story; there is a triple meaning; first the literal, second the astronomical symbolism, and third the mystic and spiritual symbolism. The first two meanings seemed to have served the last.

At the end of the eighteenth century Dupuis called attention to the correspondence between the legend of the Star of Bethlehem and the position of the Manger and of the Virgin and Child in the sky of the Nativity. More recently von Bunsen has been sufficiently impressed

by this analogy to identify the Star with the Virgo asterism* and another writer placed the Star in the constellation of Orion. From the author's standpoint these writers only were following the right trail.

To some this symbolic interpretation may seem fanciful. It is certainly foreign to our habit of thought. Modern science has tended towards intolerance of knowledge not in direct and literal form. The mythical and symbolic has come to be regarded as valueless or absurd except as a psychological study of the aberrations of the pre-scientific mind. As a result, not only the poetic beauty of truth clothed in this garb has lacked appreciation, but we tend to regard as fanciful any consistent interpretation of Oriental imagery because our attitude towards it is, though perhaps unconsciously, more or less contemptuous. At least it will be admitted that the Bethlehem legend is primarily stellar and associated with the heavens, and that such legends in the Orient are typically surrounded with luxuriant symbolism. However this is not proof that any particular interpretation is correct. But this interpretation is consistent with Oriental thought; the incidents of the legend cover the whole of the visible zodiac at the time of the solstice; they begin where the visible zodiac begins and end where it ends; and, most important of all, they are found in correct sequence throughout. Surely it is highly improbable that either chance or imagination can construct such a sequence. Again this interpretation relieves us from the difficulties of the literal version, such as the shepherds tending their flocks in the winter, the wrong date of the taxing, and the failure of Josephus and Philo, as contemporary historians, to make any mention of such an important event, as the slaying of the first born. It has the advantage even over the "unusual" versions of not requiring us to torture any date into accord with phenomena. Another point may be added in its favor; it is not unique. Contemporary birth stories of other deities can be similarly interpreted, and likewise the important celestial phenomena associated with them as we have seen.

If we grant then that this interpretation of the Star of Bethlehem is correct, how does that effect the tenets of Christianity? Dupuis would tell us that it adds proof of the mythical basis of the entire New Testament narrative.† The higher critics on the other hand would probably hold that this is but another example of the adoption and use

* C. F. Dupuis, Origine de Tous les Cultes, Paris, 1835-6 Vol. VIII, 691 et seq.; Abridged Eng. version, Origin of Religious Worship, ch. IX; E. von Bunsen, Die Plejarden und der Thierkreis.

† Archbishop Whateley has ridiculed this view in a clever skit intended to prove that Napoleon is purely a solar myth, but his cleverness cannot overcome the fact that solar myths are numerous and have played a most important role in all the older religions. Moreover the student will perceive the difference between his argument and that of Dupuis without difficulty. See Richard Whateley, Historic Doubts Relative to Napoleon Buonaparte.

by Christianity of an earlier pagan legend, or better that it is a refined and beautified composite of the numerous older pagan legends of divine births harmonized with the astronomical conditions which, in part, at least, were attached to them also. It is well known that the Church from the earliest times has accepted and modified pagan rites and ceremonies in order to accelerate its progress along the lines of least resistance. In the Christian catacombs at Rome, for example, Christ is figured as Orpheus charming the animals with his lyre and as a youthful Latin shepherd.* These critics would add that the legends of of the birth of the solar god were surrounded with a sacred and reverential character which was very useful to the early propagandists of Christianity. And again they would point to the inevitable growth of myth and legend around every great historical personage. Baron Ernest von Bunsen would probably present a third view—that the birth of the Angel Messiah upon earth was divinely ordained to accord with the solar celestial birth so that the "cosmical was regarded as a symbol of the ethical; the sun as the symbol of divine light."† From this it will be seen that if we accept the symbolic interpretation offered in this article, we may still view the legend from the standpoint of the sceptic, of liberal religion, or of orthodoxy. It may refer to an actual historical personage or, like the Egyptian book of the Dead, it may offer an ideal and symbolic description of the spiritually perfected human soul written by masters of spiritual law. If the latter view be true, the remarkable analogies of the other birth stories would suggest that this is the masterpiece of a series of such ideals. But whatever view we accept let us repeat that it is the ethical and spiritual teachings of the Master that are important, not the incidents of the story, and these teachings are in no manner injured or impeded by this interpretation of the legend. We shall only have lost a wonder tale and in its place we shall have found a song of cosmic harmony, the worthy product of the highest form of human imagination.

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* See Lanciani, Pagan and Christian Rome, pp. 23, 347 et seq.

† Angel Messiah, p. 24.

THE TOTAL ECLIPSE OF JUNE 8, 1918.

H. C. WILSON.

Within a few days after this number of POPULAR ASTRONOMY comes to your hands the eclipse, of which we wrote last month, is due to occur. Already the various astronomical expeditions are located at several different points along the path of totality and are getting their apparatus set up and adjusted. From now on they will be watching the weather conditions anxiously and hoping that the afternoon of June 8 may be perfectly clear, especially during the fateful minute and a half or two minutes of totality.

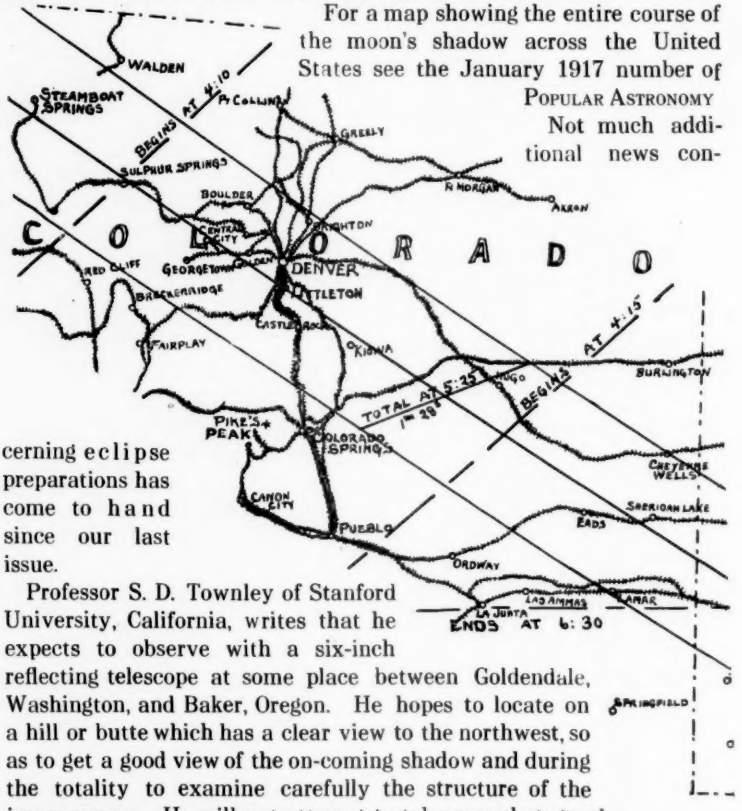
Amateurs in astronomy and curiosity seekers will undoubtedly flock in great numbers to Denver and smaller cities along the line of total eclipse on that day. For the benefit of such of our readers as desire simply to see the eclipse from the most accessible station, we print a tracing from a part of the Nautical Almanac map of the eclipse track, including the path across Colorado, Kansas and Oklahoma,—a region crossed by many railroads, and a region of exceptionally clear skies in June, excepting possibly the mountains west of Denver. It will be well to avoid the small towns where the astronomers are located, unless the train schedule is such that you can leave soon after the eclipse, for the hotel accommodations in these towns are very limited.

The lines running diagonally across the charts from N W to S E are the central line and the bounding lines of the path of the moon's shadow. The width of the shadow path in this region is about 60 miles. It will be noticed that the central line passes very close to Sulphur Springs, Central City, Littleton and Sheridan Lake in Colorado, and near Hartland, Lakin and Ashland in Kansas. Enid and Guthrie are nearest to the central line in Oklahoma, but they are both about ten miles from the middle. There are probably small stations not shown on the map which lie much closer to the central line.

Anywhere between the bounding lines of the shadow path the eclipse will be total but at the edges the duration of totality will be very short. The duration will be longer the nearer the observer gets to the central line, but anywhere within 5 miles of that line it will be near its maximum.

At Sulphur Springs the eclipse will be total for $1^m\ 32^s$, at Central City $1^m\ 31^s$, at Littleton $1^m\ 30^s$, at Sheridan Lake $1^m\ 25^s$, at Hartland $1^m\ 23^s$, at Ashland $1^m\ 21^s$, at Enid $1^m\ 16^s$, at Guthrie $1^m\ 14^s$.

In this region the partial eclipse will begin at from 4:10 to 4:25 p.m., summer time, and end from 6:27 to 6:33 p. m., summer time. Totality will occur at about 5:22 at Sulphur Springs and at about 5:32 at Guthrie.



For a map showing the entire course of the moon's shadow across the United States see the January 1917 number of POPULAR ASTRONOMY

Not much additional news concerning eclipse preparations has come to hand since our last issue.

Professor S. D. Townley of Stanford University, California, writes that he expects to observe with a six-inch reflecting telescope at some place between Goldendale, Washington, and Baker, Oregon. He hopes to locate on a hill or butte which has a clear view to the northwest, so as to get a good view of the on-coming shadow and during the totality to examine carefully the structure of the inner corona. He will not attempt to take any photographs.

A newspaper clipping states that Professor John A. Miller, of the Sproul Observatory started May 2 with a party of six, to locate their station at Brandon, Colorado. The other members of the party are: Miss Grace Jordan of Smith College, Miss Ella Williams and Miss Hazel Brown of Swarthmore College, Professor Hall and W. E. Howard of Indiana University. Senator Sproul is financing the expedition.

Professor Campbell writes, under date May 6, that the Russian eclipse apparatus of the Lick Observatory left Vladivostock two or three weeks ago, but the cable has not been able to secure information as to its

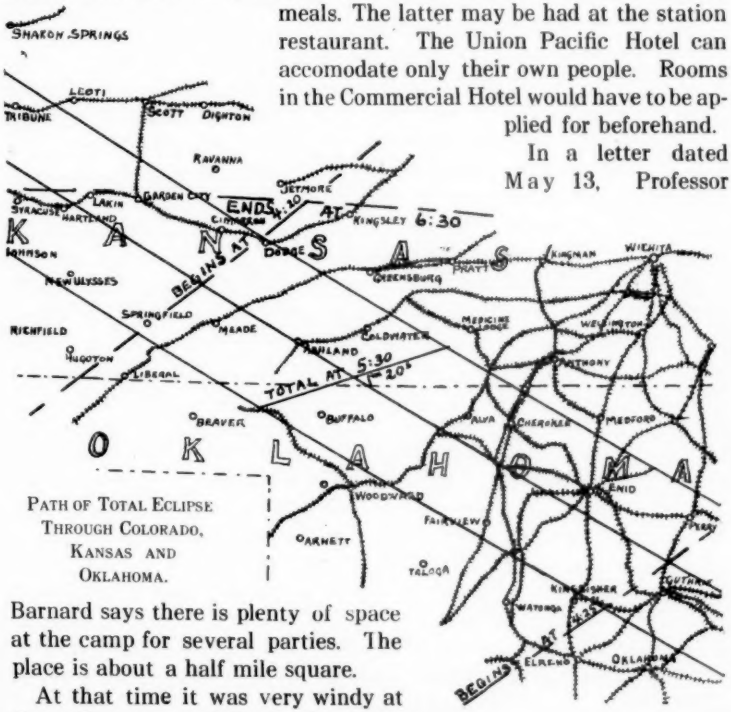
arrival in Japan or departure from Japan to an unknown American port. He says: "I have given up hope of getting it in time for use on June 8, but am glad to say that we are getting together a very respectable equipment to take its place."

Professor Joel Stebbins, of the University Observatory at Urbana, Ill., says: "We have definitely arranged that Dr. Jakob Kunz and myself will go to Rock Springs, Wyoming, for the eclipse. We expect to arrive there about May 29, and will arrange for some coöperation with Parkhurst of Yerkes Observatory, as we are about 15 miles east of them."

Professor F. P. Leavenworth of the University of Minnesota and his assistant W.O. Beal are planning to locate on one of the mountains west of Denver, and to photograph the corona and surrounding sky with two cameras.

Professor E. E. Barnard with three others of the Yerkes Observatory expedition arrived at Green River, Wyoming, on May 4. There was considerable difficulty in obtaining laborers to help set up the instruments. One hotel has 30 rooms, which are often all full, but serves no meals. The latter may be had at the station restaurant. The Union Pacific Hotel can accomodate only their own people. Rooms in the Commercial Hotel would have to be applied for beforehand.

In a letter dated May 13, Professor



PATH OF TOTAL ECLIPSE THROUGH COLORADO, KANSAS AND OKLAHOMA.

Barnard says there is plenty of space at the camp for several parties. The place is about a half mile square.

At that time it was very windy at Green River—especially in the afternoon.

LONGITUDE FROM OBSERVATIONS OF THE MOON.

R. H. TUCKER.

The rapid movement of the moon in its orbit enables us to determine the approximate difference of longitude between two stations, by observing the right ascension of the moon at both. If the absolute right ascension of the moon could be predicted without sensible error, it would only be necessary to observe at one station, and compare the result with the tabulated right ascension for the longitude of Greenwich. But the tabulated values are subject to errors, due to the failure of the application of the gravitational theory to account for some small changes in the motion of the moon. These errors are nearly constant for considerable intervals of time, but the most satisfactory method is to have the error determined at the current epoch, by observations at some established observatory.

The rate of the moon's motion at any date can be calculated in advance, with extreme precision, since it would be subject to very minute differential changes, due to the errors in the tabulated right ascensions. The error of the determination of longitude will be due to the accidental and systematic errors of observation, when the results at two stations are compared.

The accidental errors of observation are much larger than those which affect the observation of a star, as will be evident in some of the figures following. And there are probably systematic errors in observing the transits of each limb, which makes it desirable for any observer to include the transits of both limbs in the expectation that the systematic errors may be at least partially balanced in effect. The fundamental stars, from which the clock corrections are determined, should be distributed at nearly the same mean declination as that of the moon, at meridian transit, in order that possible sources of error in the measurement of the instrumental corrections shall not sensibly affect the differential determination of the right ascension of the moon.

In general, the precision of the longitude result can be predicted from the average rate of the moon's motion, which is about $0^s.04$ per second of time. This apparent rate varies from $0^s.03$, to nearly $0^s.05$; but, as already stated above, it can be very precisely calculated for any epoch desired. An error of $0^s.01$ in the observed right ascension will produce an error of a quarter of a second in the longitude, if all other data be correct. The observation of the moon's limb, at this observatory, when the usual conditions prevail, appears to be precise, since the image is sharp and steady, with but little vibration at the edge. But the irregularities of the limb, due to the variety of elevations on the moon's surface, are plainly perceptible, and the serrated effect produces some uncertainty in judging actual contacts with the transit thread. From the fact that it is a contact that is observed, rather than a bisection as in the case of a star, there may easily be some systematic difference in observing the two phenomena.

Near the close of our meridian circle work at the San Luis Observatory of the Carnegie Institution, I made a few observations of the moon as an approximate check upon the longitude of the station. For the correction to the moon's right ascension, the superintendent of the U. S. Naval Observatory at Washington kindly sent us the following preliminary values, as observed at Washington. There are two methods of using the corrections. Either the mean correction, as derived from observations of both limbs, can be adopted; or the correction, as determined for each limb, can be applied in reducing the San Luis observations of the corresponding limb. If the number of observations of each limb were the same, the mean results would be identical, for both methods.

TABLE A.

Washington Corrections to R. A. of Moon.

Dec. 12, 1910	I	+0.76
" 13	I	+0.61
" 14	I	+0.60
" 15	I	+0.71
Mean (4)	I	+0.67
Dec. 16	II	+0.65
" 17	II	+0.40
Mean (2)	II	+0.53
Half Sum		+0.60
Average residual		±0.08
Mean of 6		+0.62
Average residual		±0.08

The systematic difference between the corrections determined from the two limbs is $I - II = +0^s.14$; and the probable error of a single determination would be $\pm 0^s.08$, including the partial effect of systematic errors.

To illustrate the effect of applying the correction to the moon's right ascension, the observations at San Luis are first tabulated with the right ascensions from the *American Ephemeris*. In table B, the original observation of the limb is given first. This observation is then reduced to the equivalent right ascension of the center of the moon. The Greenwich Mean Time, at which the moon is in the corresponding right ascension, is then interpolated from the Ephemeris. By reducing this Greenwich Mean Time to sidereal time at Greenwich, and comparing the result with the San Luis sidereal time, the difference of longitude is directly derived. Also, the San Luis Mean Time of the calculated transit of the center of the moon can be compared with the interpolated Greenwich Mean Time for the corresponding right ascension. To reduce to local mean time it is necessary to know the longitude approximately, in order to obtain the local sidereal time of mean noon. The correction to apply to the tabular Greenwich sidereal time of mean noon, for the longitude of San Luis, is $+43^s.60$, for the difference of longitude $4^h\ 25^m\ 22^s$.

TABLE B.

Difference of Longitude, San Luis—Greenwich

		Dec. 13, 1910	Dec. 14	Jan. 11, 1911	Jan. 17
		h m s	h m s	h m s	h m s
Observed R. A.	I	2 59 47.95	4 2 55.60	4 36 16.93	
	II				10 59 30.92
Calculated R. A. Center		3 1 0.35	4 4 11.11	4 37 32.58	10 58 24.58
Gr. M. T. Eph. R. A.		13 59 7.45	14 58 9.80	13 41 24.24	19 37 30.90
Gr. Sid. T.		7 26 35.23	8 29 43.83	9 3 9.32	15 23 53.82
Diff. Long.		4 25 34.9	4 25 32.7	4 25 36.7	4 25 29.2
San Luis M. T.		9 33 32.60	10 32 37.10	9 15 47.54	15 12 1.68
Diff. Long.		4 25 34.9	4 25 32.7	4 25 36.8	4 25 29.2

Difference Longitude	I	$4^h\ 25^m\ 34^s.8$
	II	29.2
	Half Sum	32.0
	Mean (4)	33.4
	Average residual	± 2.4

The above tabulation shows all the steps in the method of determining the difference of longitude. The difference from the comparison of the respective sidereal times agrees with the difference between the respective mean times, within the small errors of computing the interpolated values. The systematic difference of observation of the two limbs would be $(5^s.6 \times 0^s.04)$, or $0^s.22$. The probable error of a single observation would be about $\pm 0^s.08$.

If the Ephemeris values of the right ascension of the moon be corrected by the value $+0^s.60$, from table A, the following differences of longitude will be found.

TABLE C.

R. A. Corrected by $0^s.60$.

		h	m	s
Dec. 13, 1910	I	4	25	20.0
14	I			19.0
Jan. 11, 1911	I			22.9
Mean	I			20.6
Jan. 17, 1911	II			11.7
Half Sum				16.2
Mean (4)				18.4
Average residual				± 3.3

The difference of longitude has been reduced by about 15 seconds corresponding to the application of a correction of $0^s.60$, at $0^s.04$ per second of time. The systematic difference of the two determinations, from the preceding and following limbs, $8^s.9$, is larger than in table B and the probable error of a single determination is considerably larger.

The next following table gives the longitude, with the values of the Washington corrections from each limb of the moon separately. This is equivalent to assuming that the systematic errors of observation may be similar at the two stations.

TABLE D.

Corrections: I + $0^s.67$, II + $0^s.53$.

		h	m	s
Dec. 13, 1910	I	4	25	18.3
" 14	I			17.4
Jan. 11, 1911	I			21.4
Mean	I			19.0
Jan. 17	II			13.8
Half Sum				16.4
Mean (4)				17.7
Average residual				± 2.1

The systematic error between the longitude from the two limbs is $5^s.2$, corresponding to a difference in the observations at the two stations of $0^s.21$. The probable error of a single determination is about 2^s, corresponding to ± $0^s.08$ in the observations.

The best value of the difference of the longitude from Greenwich, from these observations, with the Washington corrections to the moon's right ascension, is $4^h\ 25^m\ 18^s$, to the nearest second. The probable error of the result is at least one second. And the systematic error of a longitude determined in this manner may be expected to be of considerably larger amount.

Determinations of the geographical position, for various cities in the Argentine Republic, were made by members of the staff of the National Observatory at Cordoba, in the early years of the activity of that institution. The observations at San Luis were made in the year 1875

by Dr. Thome and Professor Bigelow, the site selected having been the Plaza de la Independencia. The results, as printed in Volume VI, page 31, in 1887, were: Latitude $-33^\circ\ 18'\ 31''.0$; Difference of Longitude from Cordoba, $+8^m\ 34^s.2$. This would give the difference of longitude from Greenwich, $4^h\ 25^m\ 22^s.4$. This determination was not accessible, at the time the San Luis observations of the moon were made. The instrument used by the Cordoba observers was known as a reflecting circle. It was practically a sextant in form, mounted, to swing freely, on a tripod. We used this instrument, later, for observing at various points in the Province of Cordoba, and I found it very convenient. Any one who has made sextant observations on land will appreciate the difficulties of finding the reflected image quickly, after making readings on the graduated arc. With the mounted instrument, the image is quickly brought back into view, by turning the slow motion screw, and observations can be repeated rapidly, by reading the circle without disturbing the position of the instrument.

It appeared to be impossible to obtain an exchange of signals with the Observatory at Cordoba, during our residence at San Luis. Repeated trips to the National telegraph office, with a chronometer, rated for the purpose, were made; but no signals were ever received. The line never was cleared for the transmission of the signals, which were presumed to be sent over all the national telegraph lines, at a fixed time, once a week. The office had its official instructions, for receipt of the signals; but notwithstanding the courtesy of the officials, from the chief down, and their well intentioned efforts to aid us, the line never transmitted any signals at the times when we were at the office. And I not ~~no~~ think any had really ever been received there. It was an instance of official procedure honored entirely in the breach, rather than in the observance. The observers at the Cordoba Observatory were doing their share, in rating a chronometer, and in sending signals over the line connected with their station.

Through our acquaintance with Mr. George Shortreede, an English surveyor, who had long been resident at San Luis, we obtained the data of a determination of the position of the Post Office made in 1908. This was given: Latitude $-33^\circ\ 18'\ 31''$; Longitude from Greenwich $4^h\ 25^m\ 25^s.2$. The longitude had apparently been determined by telegraph exchange of signals with Buenos Aires. We ran a line from the Observatory to the Post Office at San Luis, early in the morning of January 27, 1911. We had obtained permission from the chief of police, to use the streets for this purpose, so as to be free of interruption; and to have the necessary authority to restrain the good natured and curious passers, from unintentional interference. Our

small party was made up all of graduate engineers; transit man, chainmen and rodmen. The differences as measured, were: Observatory north of P. O. 3421 feet, or 33″.2; Observatory east of P. O. 3944 feet, or 46″.4 = 3ˢ.1. The resulting latitude would be −33° 17′ 58″, which differs 12″ from our meridian circle latitude of − 33° 17′ 45″.7 The resulting longitude of the Observatory would be $4^h\ 25^m\ 22^s.1$. Our friend, Mr. Shortreede, died during our last year at San Luis.

To illustrate the effect upon the longitude of the correction to the tabulated right ascensions of the moon, the following values of the correction are derived from the San Luis observations, adopting the difference from Greenwich, $4^h\ 25^m\ 22^s$.

TABLE E.

Observed Corrections to R. A. Moon.

		s
Dec. 13 1910	I	+0.52
14	I	+0.47
Jan. 11 1911	I	+0.64
Mean	I	+0.54
Jan. 17	II	+0.25
Half Sum		+0.40
Mean (4)		+0.47
Average residual		±0.11

The difference between the mean correction, 0ˢ.47, and that observed at Washington accounts for the difference in the derived longitudes, 0ˢ.15 at 0ˢ.01 per second. The small number of observations at San Luis are unequally distributed between the two limbs of the moon, owing to the interference of unfavorable weather at the close of our stay.

There appears to be a class of systematic error in observing the moon in meridian transit which affects both limbs alike, making the observed plus correction too great, if we are to accept the corrections to the moon's position which have been derived from the reductions of observed occultations of the stars. These have been discussed by Dr. Frank Ross, and by Arthur Newton of the Naval Observatory, and the results have been tabulated to date, nearly, in *No. 733* of the *Astronomical Journal.* From the tabulation on page 100, the average correction to the moon's longitude, at the epoch of our work at San Luis, was + 4″, which would give the approximate correction to the tabulated right ascensions of the moon + 0ˢ.3. The mean of the corrections at Washington and San Luis would be nearly double this quantity. Similar differences will be found for sets of observations made here, with the meridian circle. In 1907 I observed the correction to the moon's right ascension, for the use of our eclipse party, who went to Flint Island to observe the eclipse of January 3, 1908. Their

intention was to observe the moon during their stay on the island, and to use the correction, observed here at the same epoch, to obtain the longitude of the station. The following corrections were printed in our Bulletin No. 129, IV, 189, 1908.

TABLE F.

Observed Corrections to R. A. of Moon.

		s	s
Oct. 18 1907	I	+0.36	
" 28	II		+0.54
Nov. 13	I	+0.40	
" 21	II		+0.41
Dec. 12	I	+0.32	
" 20	II		+0.44
Means		+0.36	+0.46
Mean Correction		+0s.41	
Average residual		±0 .05	

With the rates of motion of sun and moon at the time of the eclipse and the above correction, the contacts would occur about 10 seconds earlier than the times computed with the tabular right ascensions of the moon in the American Ephemeris. The first contact was actually observed 23s early, and the last contact 32s early, totality being 27s early. These results were printed in the *Publications of the Astronomical Society of the Pacific* XX, 73, 1908. But one observation of the right ascension of the moon was secured at the station, owing to unfavorable conditions, and the resulting longitude was 10h 7m 10s.0. The longitude obtained by measuring from Point Venus, on the island, was 10h 7m 16s.8. The longitude from the moon observation being 6s.8 smaller, the difference might be due to the accumulated error of 0s.27 in the observations of the moon's position. For this epoch, the tabular value from the *Astronomical Journal*, referred to above, would be approximately + 3″, for the correction in longitude. The correction to the moon's right ascension at the time of the eclipse would be +0s.22, about half the quantity derived from our meridian circle observations. The eclipse should have occurred 5s early, with this value of the correction from observed occultations of stars.

For the next eclipse of June 8, 1918, the following corrections to the American Ephemeris right ascensions of the moon have been observed.

TABLE G.

Corrections to R. A. Moon

		s			s
Mar. 20 1918	I	+1.00	Jan. 30 1918	II	+0.78
" 21	I	+0.95	" 31	II	+0.71
" 22	I	+0.92	Feb. 26	II	+0.83
" 23	I	+0.94	Mar. 1	II	+0.68
Apr. 18	I	+0.95	" 29	II	+0.70
Mean	I	+0.95	Mean.	II	+0.74
Average residual		±0.02	Average residual		±0.05
Mean Correction		+0.846			

The difference of systematic errors for the two limbs is $0^s.21$. From the accidental errors of observation the probable error of the mean correction would be less than $0^s.02$. The eclipse should occur about 21^s earlier than the times calculated with the right ascension of the moon from the American Ephemeris. The tabular values of the correction to the moon's longitude in the *Astronomical Journal* have been extended forward to the epoch of this eclipse. The resulting correction is $+8''.1$. This would give a correction of $+0^s.58$ to the tabular right ascensions of the moon. A correction of $+1''.9$ had been applied in the *American Ephemeris* computations of the time of the eclipse, and a correction of $+0^s.10$ is also to be applied to the right ascension of the sun. The resulting correction would make the time of the eclipse about 10^s earlier than the computations referred to; and, for the longitude of our proposed station, the phenomena were computed to occur 13^s early.

Of the three methods of determining corrections to the moon's right ascension, the occultations appear to give the smallest values, the eclipse observations give the largest, and meridian circle observations appear to give intermediate values.

In regard to the systematic error of the observations of the limbs of the moon, it may have a similar source to that of the magnitude equation in transits. Both are more likely to be due to the psychological error in the coördination of eye, brain, and hand, rather than to actual error in estimating contact or bisection. Since the effect of the magnitude equation for the writer amounts to about three quarters of a second of arc for a difference of five magnitudes, it is not probable that such an error could be made in bisecting a faint star, the image of which is about one second of arc in diameter. Such an error might be made in the bisection of the larger images of bright stars. But the effect is most probably due to the reaction time of the senses, in responding to the visual phenomena, more intense for the bright objects, and consequently more rapid. Since the moon's limb is very brilliant, the similar explanation would make the record earlier than those of the stars; but the difference of contact and bisection phenomena, at the transit threads, is probably more important as a source of systematic error than the reaction time, which may be assumed to explain the usual form of magnitude equation in star transits. A similar case may be presented in the meridian transit of *Venus*, observed by me on March 2, civil date. The observation of the following limb of the planet gives a correction of $+0^s.09$ to the tabular value of the right ascension from the *American Ephemeris*. From the occultation of the star 7 *Aquarii*, observed on the same date with the equatorial telescopes here, the correction to the right ascension of *Venus* was

computed to be $-2''.0$, or $-0^s.14$. (*Pub. Astr. Soc. Pac.* XXX, 169, 1918.) The correction derived from the occultation differs $0^s.23$ from that derived from the meridian circle observations, with the same algebraic sign as in the correction for the moon. As the meridian transit occurred less than two hours before noon, the effect of irradiation at the limb of the planet must have been very much reduced, and probably produced no sensible error.

For a comparison of the accidental errors of the observations of the moon and stars, the latest series of ten observations of the moon may be taken as an illustration. There were 41 standard clock stars used in this series. The average probable error of a single determination of clock correction was $\pm 0^s.033$. This includes the errors of the tabulated right ascensions of the stars of the *American Ephemeris*. Not all of the stars employed are contained in the *Berliner Jahrbuch*, but the average difference of the right ascensions of a group of stars on any one night, from the two authorities, is about $0^s.01$. The probable error of the derived clock correction should be less than $0^s.02$. The groups of stars employed differ, in their mean declination, from the declination of the moon by less than $3°$. The sum of the instrumental corrections of the stars differs from that of the moon by an average of less than $0^s.02$. The probable error of observation of a star made with this instrument does not exceed $0^s.02$, as a rule, and the purely accidental error of the observation of the limb of the moon is from two to four times that quantity.

May 4, 1918.

PLANET NOTES FOR JULY AND AUGUST, 1918.

The sun at the beginning of this period will already have begun to move southward and the days in this latitude will be getting shorter. It will change its declination from 23° 9′ north on July 1 to 8° 51′ north on August 31. It will move eastward from Gemini through Cancer into Leo. In the latter part of August it will pass very near the bright star Regulus.

The phases of the moon for these months are as follows:

New Moon	July	8 at	2 A.M.	C.S.T.
First Quarter		15 "	12 P.M.	"
Full Moon		23 "	3 P.M.	"
Last Quarter		30 "	7 A.M.	"
New Moon	Aug.	6 at	2 P.M.	C.S.T.
First Quarter		14 "	5 P.M.	"
Full Moon		21 "	11 F.M.	"
Last Quarter		28 "	1 P.M.	"

For the summer time of these phases one hour must be added to the times given.

Mercury may be visible for a few evenings about August 5 just after sunset. On this date it will reach a point of greatest elongation. It will, however, be about ten degrees to the south of the sun, which is unfavorable to its being seen here. If it is not visible at this time, it will not be visible at all during these months, as it is just emerging from the sun's rays at the beginning and will again be lost in them at the end.

Venus will move eastward a little more rapidly than the sun during this period. It will therefore rise later each morning than on the preceding morning. It will be visible in the eastern sky up to the end of August, but towards the end will be very near the horizon at sunrise.

Mars will be visible in the west in the evening during these months. Toward the end of August, however, it will be too low in the sky for favorable observations.

Jupiter at the beginning of July will just be becoming visible again as a morning star. The sun will be moving eastward much faster than Jupiter and by the end of August, Jupiter will be well up in the sky at sunrise.

Saturn will just be visible in the west at sunset at the beginning of July. It will, however, soon be lost in the rays of the sun and on August 11 it will be in conjunction with the sun and practically invisible for the rest of the month.

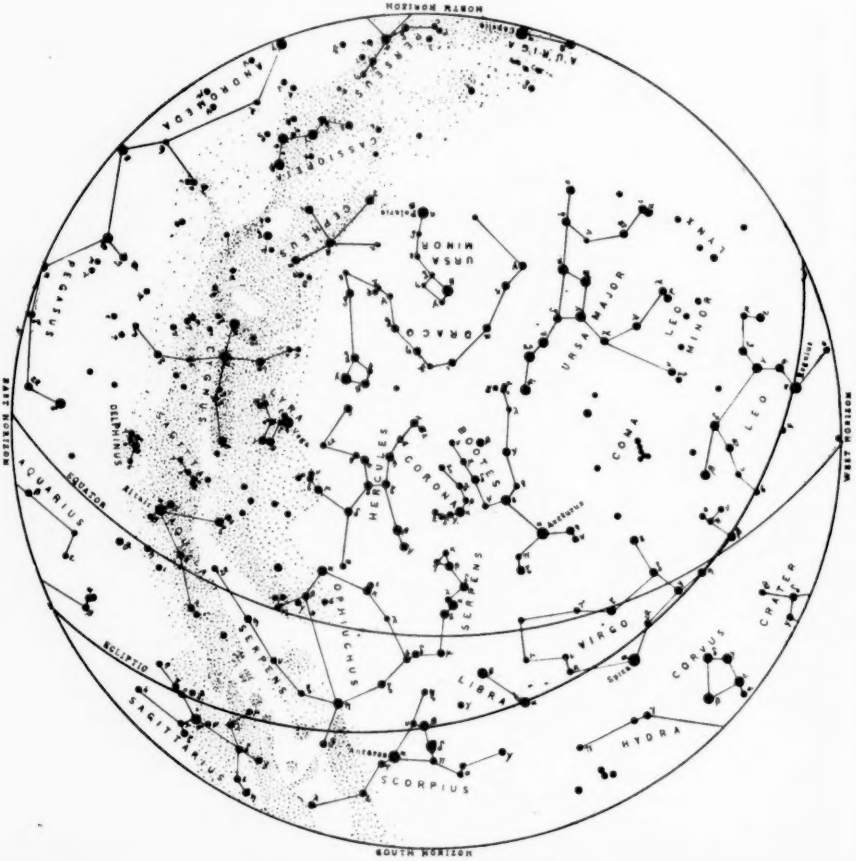
Uranus will be in opposition to the sun on August 19. It will therefore be favorably situated for observation throughout these two months.

Neptune will be in conjunction with the sun on July 30, and will consequently be invisible during this period.

Occultations Visible at Washington.

[*From the American Ephemeris.*]

Date 1918	Star's Name	Magnitude	IMMERSION. Washington M.T. h	m	Angle from N. °	EMERSION. Washington M.T. h	m	Angle from N. °	Duration h	m
July 20	57 Ophiuchi	4.8	7	29	65	8	45	298	1	16
23	τ Capricorni	5.2	16	20	40	17	17	268	0	56
31	A Tauri	4.5	15	16	67	16	24	262	1	7
31	39 Tauri	6.1	15	32	90	16	40	239	1	8
Aug. 2	141 Tauri	6.3	15	8	58	15	58	296	0	51
11	370 B Virginis	6.0	6	40	110	7	56	294	1	16
18	π Sagittarii	3.0	11	50	82	12	58	236	1	8
27	14 H^1 Tauri	6.5	10	17	46	11	2	284	0	45
27	22 H^1 Tauri	6.1	12	28	122	13	8	203	0	40



THE CONSTELLATIONS AT 9:00 P. M. JULY 1.

VARIABLE STARS.

Minima of Variable Stars of Short Period.

[Calculated by Julia M. Hawkes and Frank M. Exner at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract 5^h; Central Standard 6^h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1918 July-August							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8	1 0			4 21				
RT Sculptor.	31.5	−26 13	9.6—10.5	0 12.3	3 7;	18 16;	3 0;	18 8				
UU Androm.	38.5	+30 24	10.7—11.9	1 11.7	6 22;	21 19;	5 16;	20 13				
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	8 3;	23 2;	7 1;	22 0				
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	5 7;	23 15;	4 21;	23 5				
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	8 6;	22 13;	5 20;	20 2				
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	3 22;	24 12;	7 6;	20 23				
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	7 15;	21 23;	5 8;	26 20				
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	8 3;	25 16;	3 11;	21 0				
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	9 20;	25 17;	2 16;	18 13				
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6	1 18		3 2					
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	7 16;	24 21;	5 8;	22 13				
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	8 11;	22 1;	11 10;	25 1				
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	8 13;	24 8;	9 4;	24 23				
RW Tauri	3 57.8	+27 51	7.1—<11	2 18.5	3 4;	19 19;	5 10;	22 0				
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	4 6;	20 1;	4 20;	20 15				
RW Persei	13.3	+42 04	8.8—11.0	15 04.8	11 18;	24 23;	7 4;	20 8				
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	3 2;	21 23;	9 20;	28 18				
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	10 14;	23 0;	4 10;	29 6				
TT Aurigae	5 2.80	+39 27	7.8— 8.7	0 16.0	3 0;	23 0;	12 0;	25 8				
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	5 2;	21 11;	6 20;	23 5				
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	4 14;	22 15;	3 16;	21 18				
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	2 16;	20 0;	6 8;	23 16				
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	7 16;	28 11;	7 21;	28 16				
SV Gemin.	54.6	+24 28	9.8—<11	4 00.2	4 22;	29 22;	5 23;	22 0				
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	3 12;	20 17;	1 4;	18 9				
U Columbae	6 11.2	−33 03	9.2—10.0	2 19.2	8 1;	24 20;	5 1;	21 20				
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	9 6;	25 16;	11 1;	27 11				
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	7 12;	22 18;	14 15;	29 21				
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	4 0;	28 10;	9 15;	21 20				
RU Monoc.	6 49.4	− 7 28	9.8—10.5	0 21.5	5 18;	20 2;	3 10;	17 18				
R Can. Maj.	7 14.9	−16 12	5.8— 6.4	1 03.3	8 0;	21 15;	11 2;	24 17				
RY Gemin.	21.7	+15 52	8.9—<10	9 07.2	7 1;	25 15;	13 6;	31 20				
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	5 8;	25 4;	7 10;	20 15				
TX Gemin.	30.3	+17 8	10.0—11.9	2 19.2	5 10;	22 5;	8 0;	24 20				
RR Puppis	43.5	−41 08	9.4—10.7	6 10.3	11 9;	24 5;	12 12;	25 9				
V Puppis	7 55.4	−48 58	4.1— 4.8	1 10.9	2 6;	24 2;	7 15;	22 4				
X Carinae	8 29.1	−58 53	7.9— 8.7	0 13.0	1 18;	18 0;	3 6;	19 12				
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	6 8;	25 8;	3 19;	22 18				
RX Hydrae	9 00.8	− 7 52	9.1—10.5	2 6.8	9 1;	22 17;	5 10;	19 3				
S Velorum	29.4	−44 46	7.8— 9.3	5 22.4	4 12;	22 7;	3 4;	20 23				
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	9 2;	22 13;	5 1;	25 7				
RR Velorum	10 17.8	−41 36	10.0—10.9	1 20.5	7 10;	22 6;	13 12;	28 8				
SS Carinae	10 54.2	−61 23	12.2—12.8	3 07.2	10 6;	23 11;	5 16;	25 11				
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	9 5;	26 19;	13 10;	31 0				
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	4 11;	19 3;	2 18;	17 10				
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	7 4;	20 18;	10 3;	23 17				
RZ Centauri	12 55.6	−64 05	8.5— 8.9	1 21.0	2 4;	17 5;	8 17;	23 17				
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.2	9 15;	28 20;	7 10;	26 14				
SS Centauri	13 07.2	−63 37	8.8—10.4	2 11.5	1 17;	24 0;	7 21;	22 18				
δ Librae	14 55.6	− 8 07	4.8— 6.2	2 07.9	2 2;	16 1;	6 0;	26 23				

Minima of Variable Stars of Short Period—Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1918 July-August							
	h m	° ′		d h	d h	d h	d h	d h				
U Coronae	15 14.1	+32 01	7.6— 8.7	3 10.9	6 7;	20 3;	9 20;	23 15				
TW Draconis	32.4	+64 14	7.3— 8.9	2 19.3	2 14;	19 10;	5 6;	22 2				
SS Librae	15 43.4	—15 14	9.3—11.5	0 18.4	7 20;	23 3;	7 11;	22 18				
SW Ophiuchi	16 11.1	— 6 44	9.2—10.0	2 10.7	6 5;	20 21;	4 13;	19 5				
SX Ophiuchi	12.6	— 6 25	10.5—11.2	2 01.5	4 0;	20 13;	6 1;	22 13				
R Arae	31.1	—56 48	6.8— 7.9	4 10.2	3 0;	20 17;	7 10;	25 3				
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1	10 6;	21 8;	11 2;	20 19				
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	5 23;	19 14;	2 4;	22 14				
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	2 6;	19 1;	4 19;	21 14				
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	7 22;	20 5;	7 16;	20 0				
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	4 1;	18 11;	9 2;	23 12				
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	2 18;	17 12;	8 15;	23 9				
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	8 23;	25 7;	10 16;	27 1				
TX Scorpii	48.6	—34 13	7.5— 8.2	0 22.6	6 12;	21 14;	5 16;	20 18				
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	8 2;	23 13;	8 1;	23 13				
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	3 14;	19 13;	4 13;	20 12				
WX Sagittae	53.6	—17 24	9.2—10.8	2 03.1	4 0;	21 1;	7 2;	24 3				
WY Sagittae	17 54.9	—23 1	9.5—10.6	4 16.0	3 6;	21 22;	9 14;	28 6				
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	9 21;	30 14;	9 22;	30 14				
RS Sagittarii	11.0	—34 08	5.9— 6.3	2 1.00	7 5;	21 17;	5 5;	19 17				
V Serpentis	11.1	—15 34	9.5—11.1	3 10.9	4 1;	17 21;	7 14;	21 10				
RZ Scuti	21.1	— 9 15	7.4— 8.3	15 03.2	13 4;	28 7;	12 10;	27 13				
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	5 1;	19 9;	9 21;	24 4				
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	9 0;	23 5;	6 11;	20 16				
SX Sagittarii	39.7	—30 36	8.7— 9.8	2 01.8	3 6;	19 20;	5 11;	22 2				
RR Draconis	40.8	+62 34	9.3—13	2 19.9	7 21;	24 21;	10 21;	27 20				
RS Scuti	43.7	—10 21	9.3—10.3	0 15.9	7 3;	20 10;	9 9;	22 15				
β Lyrae	46.4	+33 15	3.4— 4.1	12 21.8	11 7;	24 5;	6 3;	19 0				
U Scuti	18 48.9	—12 44	9.1— 9.6	0 22.9	7 14;	22 20;	7 3;	22 10				
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	2 5;	17 8;	9 2;	24 5				
RV Lyrae	12.5	+32 15	11. —12.8	3 14.4	8 17;	23 3;	6 12;	20 22				
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	4 8;	22 6;	9 3;	27 1				
U Sagittae	14.4	+19 26	6.5— 9.0	3 09.1	7 3;	20 15;	9 22;	23 11				
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	3 17;	18 11;	2 4;	16 22				
TT Lyrae	24.3	+41 30	9.3—11.6	5 05.8	8 9;	24 3;	8 20;	24 14				
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	5 15;	18 16;	7 5;	20 6				
SY Cygni	19 42.7	+32 28	10 —12	6 00.2	5 8;	17 8;	4 9;	22 9				
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	7 1;	20 7;	2 14;	15 20				
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	4 1;	22 8;	9 15;	27 22				
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	2 18;	19 15;	5 11;	22 8				
RW Capric.	12.2	—17 59	8.8—10.6	3 09.4	5 16;	19 5;	8 14;	22 4				
UW Cygni	19.6	+42 55	10.5—10.8	3 10.8	6 8;	20 3;	9 20;	23 16				
V Vulpec.	32.3	+26 15	8.2—9.8	37 19.0	2 14		9 9					
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	8 12;	27 17;	6 8;	25 13				
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	9 16;	28 1;	6 6;	24 15				
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	3 1;	18 1;	2 0;	24 12				
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	3 7;	18 11;	2 16;	25 11				
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	7 6;	27 11;	6 13;	26 18				
VV Cygni	21 02.3	+45 23	12.1—13.8	1 11.4	7 23;	22 18;	6 12;	21 7				
AE Cygni	09.0	+30 20	10.8—11.4	0 23.3	6 6;	25 15;	4 8;	23 17				
RY Aquarii	14.8	—11 14	8.8—10.4	1 23.2	3 8;	19 2;	3 19;	19 13				
RT Lacertae	21 57.4	+43 24	9.1—10.5	5 01.7	3 4;	23 11;	2 14;	22 21				
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3	10 10		10 17					
RW Lacertae	22 40.6	+49 08	10.2—11.2	5 04.4	8 21;	24 10;	8 23;	24 13				
TT Androm.	23 08.7	+45 36	11.3—12.6	2 18.3	2 22;	27 20;	5 3;	21 17				
Y Piscium	29.3	+ 7 22	9.0—12.0	3 18.4	3 13;	18 15;	10 5;	25 7				
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	3 12;	19 23;	5 11;	21 23				

Maxima of Variable Stars of Short Period.

[Calculated by Julia M. Hawkes at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time. To obtain Eastern standard time subtract 5h; Central standard time 6h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1918. July-August							
	h m	° ′		d h	d	h	d	h	d	h	d	h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7	13	7			18	20		
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 1.7	3	0;	19	7;	4	13;	20	20
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	6	20;	22	8;	6	20;	22	7
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	8	17;	23	12;	7	7;	22	3
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	7	12;	23	9;	8	6;	24	3
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	6	17;	22	7;	6	21;	22	11
TU Persei	3 01.8	+52 49	11.4—12.2	0 14.6	8	18;	23	7;	6	21;	21	11
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0	2		18		3		19	
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	8	19:	25	23;	12	3;	29	6
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	6	13;	28	19;	8	23;	31	5
RX Aurigae	4 54.5	+39 49	7.2— 8.1	11 15.0	5	4;	28	10;	9	1;	20	16
SX Aurigae	5 04.6	+42 02	8.0— 8.7	1 12.8	7	1;	22	8;	6	16;	21	23
SY Aurigae	05.5	+42 41	8.4— 9.5	10 03.3	11	20;	21	23;	11	6;	21	9
Y Aurigae	21.5	+42 21	8.6— 9.6	3 20.6	5	7;	20	17;	5	4;	20	14
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	5	6;	16	8;	7	11;	18	12
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	2	22;	18	2;	9	18;	24	22
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3			14	3;	10	3		
RT Aurigae	23.0	+30 33	5.1— 6.0	3 17.5	6	8;	21	6;	5	4;	20	2
RZ Camelop.	23.7	+67 06	11.0—13.0	0 11.5	12	23;	27	9;	10	19;	25	5
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	8	23;	24	19;	9	15;	25	11
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	4	8;	24	16;	3	19;	24	3
RU Camelop.	7 10.9	+69 51	8.5— 9.8	12 06.5	9	12;	31	18;			23	1
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	6	10;	22	7;	7	5;	23	2
V Carinae	8 26.7	−59 47	7.4— 8.1	6 16.7	7	3;	20	13;	9	15;	23	0
T Velorum	8 34.4	−47 01	7.6— 8.5	4 15.3	2	11;	21	0;	8	14;	27	3
V Velorum	9 19.2	−55 32	7.5— 8.2	4 08.9	4	1;	21	13;	8	0;	25	12
Z Leonis	9 46.4	+27 22	7.9— 9.6	59 0.00	3						31	
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	11	19;	25	9;	7	23;	21	12
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	9	1;	22	6;	11	2;	24	6
S Muscae	12 07.4	−69 36	6.4— 7.3	9 15.8	4	10;	23	18;	2	9;	21	17
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	4	4;	20	2;	5	1;	21	0
T Crucis	15.9	−61 44	6.8— 7.6	6 17.6	5	17;	19	4;	8	9;	21	20
R Crucis	18.1	−61 04	6.8— 7.9	5 19.8	9	5;	20	21;	7	8;	24	20
S Crucis	12 48.4	−57 53	6.5— 7.6	4 16.6	5	9;	19	10;	7	5;	21	6
W Virginis	13 20.9	− 2 52	8.7—10.4	17 06.5			17	20;	4	3	21	9
SS Hydrae	25.0	−23 08	7.4— 8.1	8 4.8	7	5;	23	15;	9	0;	25	10
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	4	2;	18	3;	8	4;	22	5
ST Virginis	14 22.5	− 0 27	10.3—11.4	0 09.9	5	18;	22	4;	7	14;	24	1
V Centauri	25.4	−56 27	6.4— 7.8	5 11.9	8	2;	24	13;	10	1;	26	12
RS Bootis	29.3	+32 11	8.6—10.0	0 09.1	7	5;	22	7;	13	22;	29	0
RU Bootis	14 41.5	+23 44	12.8—14.3	0 11.9	12	8;	27	4;	10	23;	25	19
R Triang. Austr.	15 10.8	−66 08	6.7— 7.4	3 09.3	4	23;	25	6;	7	20;	28	4
S Triang. Austr.	15 52.2	−63 29	6.4— 7.4	6 07.8	7	19;	20	11;	8	10;	21	2
S Normae	16 10.6	−57 39	6.6— 7.6	9 18.1	3	4;	22	16;	11	5;	30	17
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	8	12;	26	5;	4	2;	21	19
RV Scorpii	16 51.8	−33 27	6.7— 7.4	6 01.5	4	8;	22	12;	9	17;	21	20
X Sagittarii	17 41.3	−27 48	4.4— 5.0	7 00.3	11	8;	25	9;	8	9;	22	10
Y Ophiuchi	47.3	− 6 07	6.1— 6.5	17 02.9			16	14;	2	17		
W Sagittarii	17 58.6	−29 35	4.3— 5.1	7 14.3	7	19;	22	23;	7	4;	29	23
Y Sagittarii	18 15.5	−18 54	5.4— 6.2	5 18.6	10	10;	21	23;	8	7;	19	20
U Sagittarii	26.0	−19 12	6.5— 7.3	6 17.9	12	17;	26	5;	8	16;	22	4
Y Scuti	32.6	− 8 27	8.7— 9.2	10 08.3	5	12;	26	4;	5	12;	26	5
Y Lyrae	18 34.2	+43 52	11.3—12.3	0 12.1	11	13;	23	14;	10	17;	22	18

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1918. July-August							
	h m	° ′		d h	d	h	d	h	d	h	d	h
RZ Lyrae	18 39.9	+32 42	9.9—11.2	0 12.3	12	20;	25	3;	6	9;	24	19
RT Scuti	44.1	−10 30	9.1— 9.7	0 11.9	10	10;	28	6;	9	3;	27	0
κ Pavonis	18 46.6	−67 22	3.8— 5.2	9 02.2	9	10;	27	14;	5	16;	23	21
U Aquilae	19 24.0	− 7 15	6.2— 6.9	7 00.6	5	20;	26	21;	9	23;	24	0
XZ Cygni	30.4	+56 10	8.6— 9.3	0 11.2	10	0;	24	0;	14	0;	28	0
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	6	7;	22	6;	7	5;	23	4
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	3	16;	19	2;	3	11;	18	20
η Aquilae	47.4	+ 0 45	3.7— 4.5	7 04.2	6	3;	20	12;	3	20;	18	5
S Sagittae	51.5	+16 22	5.6— 6.4	8 09.2	6	23;	23	18;	9	12;	26	6
X Vulpec.	19 53.3	+26 17	9.51—0.5	6 07.7	4	23;	23	22;	11	21;	24	12
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3			16	13;	1	23;	18	8
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	5	15;	23	9;	10	13;	23	10
WY Cygni	52.3	+30 03	9.6—10.4	0 13.5	6	2;	19	13;	8	18;	22	5
RV Capric.	55.9	−15 37	9.2—10.1	0 10.7	3	14;	23	18;	6	4;	26	7
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	9	17;	24	10;	8	4;	22	21
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	10	23;	26	17;	11	10;	27	3
SW Aquarii	10.2	− 0 20	9.9—10.8	0 11.0	12	17;	26	12;	9	7;	23	2
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	9	8;	23	23;	7	13;	22	3
Y Lacertae	22 05.2	+50 33	9.1— 9.6	4 07.8	10	11;	27	18;	14	1;	31	9
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	10	8;	26	10;	11	12;	27	15
Z Lacertae	36.9	+56 18	8.2— 9.0	10 21.1	7	23;	29	17;	9	15;	31	9
RR Lacertae	37.5	+55 55	8.5— 9.2	6 10.1	9	17;	22	13;	10	19;	23	15
V Lacertae	22 44.5	+55 48	8.5— 9.5	4 23.6	9	16;	24	15;	8	14;	23	12
X Lacertae	45.0	+55 54	8.2— 8.6	5 10.7	11	18;	28	2;	8	10;	24	8
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	10	20;	27	4;	7	1;	23	9
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	9	11;	22	1;	9	23;	22	13
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	11	19;	23	22;	5	2;	29	8
V Cephei	23 51.7	+82 38	6.0—7.0	0 23.6	4	11;	24	10;	8	9;	23	8

NOTES FOR OBSERVERS.

Monthly Report of the American Association of Variable Star Observers, April-May, 1918.

The Spring Meeting of the Association was held at the home of the President, Mr. D. B. Pickering, at East Orange, N. J., May 4, 1918.

The following members were present:—Misses Block and Reed, Messrs Burbeck, Campbell, Delmhorst, Gould, Jordan, Olcott, Pickering, McAteer, Ray, Reardon and Whitehorn.

The occasion was a most enjoyable one and again we express our obligations and gratitude to Mr. and Mrs. Pickering for their gracious hospitality.

Mr. Jordan's notes, in brief, of the special features of the business meeting follow:—

President David B.Pickering presided.

Reports of the Secretary and Treasurer were read and approved.

It was voted that the Association has learned with deep regret of the death of its fellow member, the late Paul S. Yendell, of Dorchester, Mass., and that a page on the records be set apart in his memory, and an expression of the sympathy of the Association be conveyed to his bereaved family.

VARIABLE STAR OBSERVATIONS Apr.-May, 1918.

March 0 = 2421653 April 0 = 2421684 May 0 = 2421714

001032
S Sculptoris

J.D.	Est.	Obs.
242		
1603.6	7.6	δ

001046
X Androm.

1641.3	9.3	Lt
65.3	9.0	Lt

001726
T Androm.

1632.3	9.0	Lt
64.3	9.3	Lt
85.5	11.0	Ba

003179
Y Cephei

1685.6	< 13.0	Ba

004047
U Cassiop.

1640.4	8.6	Lt
85.5	11.7	Ba

004435
V Androm.

1641.3	10.1	Lt

004958
W Cassiop.

1685.5	12.1	Ba

011272
S Cassiop.

1690.6	< 13.0	Ba

012350
RZ Persei

1686.5	10.3	Y

014958
X Cassiop.

1685.6	< 12.5	Ba

015354
U Persei

1685.6	11.0	Ba
88.6	10.8	Wh

021024
R Arietis

1641.3	9.9	Lt
63.3	7.8	L
65.3	9.6	Lt
75.3	7.3	L
77.3	7.2	L

021281
Z Cephei

1685.6	< 13.0	Ba

021403
o Ceti

J.D.	Est.	Obs.
242		
1603.6	5.6	δ
22.2	5.8	Be
23.2	5.8	Be
27.3	5.8	Be
27.3	6.2	Lt
28.3	6.4	Lt
30.2	6.1	Be
32.3	6.6	Lt
33.3	6.1	Be
34.3	6.8	L
36.3	6.2	L
36.3	6.5	Be
41.3	6.8	Lt
42.3	6.8	Lt
43.3	6.6	L
50.3	7.0	Lt
51.5	6.8	δ
63.3	7.6	L
63.3	7.1	Lt
64.2	7.6	Pe
65.3	7.5	L
65.3	7.5	Be
69.3	7.6	L

021558
S Persei

1685.5	9.3	B
85.6	9.0	Ba

022150
RR Persei

1685.6	< 12.5	Ba
86.5	< 13.0	Y

022813
U Ceti

1651.5	10.2	δ

023080
RR Cephei

1685.6	10.3	Ba

023133
R Trianguli

1641.3	11.0	Lt

024356
W Persei

1685.5	8.4	Ba
86.7	9.0	Mu
88.6	8.8	Wh
89.6	8.5	Hu

030514
U Arietis

1686.5	8.0	Y

031401
X Ceti

1641.3	11.5	Lt
56.6	9.3	δ

032043
Y Persei

J.D.	Est.	Obs.
242		
1685.6	8.5	Ba
86.7	8.7	Mu
89.6	8.3	Hu

032335
R Persei

1640.4	8.9	Lt
90.6	12.0	Hu
98.6	11.7	Ba

033362
U Camelop.

1632.3	8.0	Lt
43.5	8.0	Lt
85.6	7.3	Ba
88.6	8.0	Wh

034124
S Fornacis

1656.6	8.6	δ
69.6	8.6	δ

014625
U Eridani

1856.6	12.1	δ
69.6	11.7	δ

035124
T Eridani

1656.6	8.0	δ
69.6	8.6	δ

041619
T Tauri

1685.5	9.9	Ba

042209
R Tauri

1698.6	9.5	Ba

042215
W Tauri

1661.2	9.9	Pe
64.2	10.1	Pe
85.5	10.0	Ba
86.6	9.9	Y
86.7	10.1	Mu
88.6	10.2	Wh
90.6	10.4	Hu
90.6	9.9	Ba
98.5	9.8	Ba

042309
S Tauri

1698.6	< 12.0	Ba

043065
T Camelop.

1641.3	10.9	Lt
53.3	9.9	Lt
88.6	9.2	Wh
90.6	8.8	Ba

043208
RX Tauri

J.D.	Est.	Obs.
242		
1688.6	< 12.0	Ba

043274
X Camelop.

1640.4	8.3	Lt
50.5	8.3	Lt
85.5	8.8	B
88.6	9.3	Y
90.6	8.9	Hu
90.6	9.0	Ba

044617
V Tauri

1685.5	9.8	Ba
86.5	9.5	B
89.6	9.4	Y

045307
R Orionis

1685.5	11.0	Ba
86.6	10.5	Y

045514
R Leporis

1628.3	8.8	Lt
34.3	7.3	L
42.4	8.8	Lt
53.3	8.6	Lt
63.3	8.6	L
70.3	8.5	L
85.5	7.3	Ba

050003
V Orionis

1685.5	9.2	Ba
85.5	9.2	B
86.6	9.2	Y
86.6	9.3	Wh

050022
T Leporis

1651.5	9.6	δ
56.6	9.6	δ
64.2	10.5	Pe
69.6	10.1	δ
85.5	10.5	Ba

050849
UX Aurigae

1653.3	9.1	Lt

050953
R Aurigae

1685.5	11.8	Ba

052034
S Aurigae

1665.3	9.1	Pe
70.3	9.1	L
81.5	9.0	B
85.5	8.7	Ba
85.7	8.9	Wh

052036
W Aurigae

J.D.	Est.	Obs.
242		
1685.5	< 12.7	Ba

052404
S Orionis

1632.3	7.9	Lt
40.4	7.7	Lt
85.6	8.2	Ba

053005 a
T Orionis

1661.3	9.5	Pe
64.3	9.6	Pe
70.3	10.1	L
85.6	10.0	Ba
89.6	10.3	Wh

053068
S Camelop.

1688.6	9.3	Wh
90.6	8.8	Ba

053326
RR Tauri

1685.6	12.2	B

053531
U Aurigae

1686.6	11.6	Y
90.6	12.5	Ba

053920
Y Tauri

1632.3	7.8	Lt
43.4	7.7	Lt

054319
SU Tauri

1634.3	9.6	L
36.3	9.7	L
61.3	9.9	Pe
63.3	9.4	L
64.3	9.8	Pe
65.3	9.4	L
66.7	9.4	Me
69.3	9.4	L
69.3	9.4	Be
70.3	9.4	L
71.3	9.2	L
72.3	9.4	L
75.3	9.4	L
77.3	9.3	L
77.3	9.3	Be
81.3	9.5	L
81.5	9.4	B
84.6	9.4	Ba
85.5	9.4	B
85.5	9.4	Ba
85.6	9.6	Wh
86.6	9.4	Ba

VARIABLE STAR OBSERVATIONS, Apr.-May, 1918—Continued.

SU Tauri

J.D. 242	Est.	Obs.
88.6	9.8	V
89.6	9.4	Ba
90.6	9.5	Ba
91.6	9.4	Ba
93.6	9.5	V
97.6	9.4	V
98.5	9.4	Ba
1709.5	9.5	B
10.5	9.6	B
11.5	9.5	B
16.5	9.5	Ba

054615
RU Tauri

1686.5	11.0	Y

054615
Z Tauri

1686.5	10.9	Y

054920
U Orionis

1661.3	11.2	Pe
64.3	10.4	Pe
85.6	9.0	Ba
86.5	9.5	B
89.6	9.2	Hu

054974
V Camelop.

1684.6	<13.5	Ba
85.5	<13.3	Ba
86.6	<13.0	Ba
89.6	<13.3	Ba
90.6	10.0	Hu
90.6	<12.8	Ba
91.6	<13.3	Ba
98.6	<13.3	Ba
99.7	<13.0	Ba
1716.5	<13.0	Ba

055353
Z Aurigae

1690.6	10.4	Ba

060450
X Aurigae

1641.3	10.1	Lt
53.3	9.2	Lt
86.7	8.5	Wh
89.6	8.2	Hu
90.6	8.2	Ba
98.6	8.5	Ba
99.6	9.3	M
1710.6	9.2	B

060547
SS Aurigae

1634.3	<12.4	L
35.5	<12.4	L
36.3	<12.4	L

SS Aurigae

J.D. 242	Est.	Obs.
43.7	<11.6	L
63.3	<12.4	L
65.3	<12.4	L
67.3	<11.3	L
70.3	<12.4	L
71.3	<11.6	L
72.3	<11.6	L
75.3	<11.6	L
81.2	11.2	L
81.5	11.1	B
84.6	11.4	B
84.6	11.4	Ba
85.5	12.0	B
85.5	12.0	Ba
85.7	11.9	Wh
86.5	12.4	Y
86.5	12.8	B
86.6	12.6	Ba
88.6	<13.0	Y
89.5	<13.0	Y
89.6	<14.2	Ba
90.6	<13.5	Ba
91.6	<13.5	Ba
98.6	<13.5	Ba
99.7	<12.5	Ba
1710.5	<12.6	B

061647
V Aurigae

1690.6	11.9	Ba

061702
V Monoc.

1690.6	<12.0	Hu
90.6	<12.4	Ba

062230
RT Aurigae

1622.2	5.4	Be
27.2	5.8	Be
28.2	5.2	Be
30.2	5.4	Be
33.2	5.3	Be
34.2	5.8	Be
34.2	5.7	L
36.2	4.9	L
51.2	5.2	L
62.3	5.1	Be
63.2	5.4	L
63.3	5.4	Be
64.3	5.4	Be
65.2	5.4	L
65.2	5.3	Be
66.3	5.0	Be
69.2	5.3	L
69.3	5.3	Be
70.3	5.2	Be
70.3	5.1	L
77.3	5.0	L
77.3	5.0	Be
90.3	5.3	Be
91.3	5.5	Be

063159
U Lyncis

J.D. 242	Est.	Obs.
1685.6	<12.3	B
88.6	12.4	Y
90.6	13.0	Ba

063308
R Monoc.

1689.6	11.3	Wh
98.6	10.1	Ba

063558
S Lyncis

1690.6	12.7	Hu
90.6	13.4	Ba

064030
X Gemin.

1698.6	13.1	Ba

064932
Nova. Gem. II

1663.3	12.0	L
65.3	12.1	L

065111
Y Monoc.

1686.6	11.5	Y
98.6	10.6	Ba

065208
X Monoc.

1651.5	8.4	δ
56.5	8.5	δ
62.6	9.0	δ
65.3	9.0	L
69.6	9.2	δ
70.3	9.0	L
90.6	9.0	Hu
98.6	7.6	Ba

065355
R Lyncis

1640.4	9.3	Lt
86.6	7.8	Y
98.6	7.3	Ba

070109
V Can. Ven.

1689.6	<13.5	Ba

070122a
R Gemin.

1641.3	10.7	Lt
61.3	11.8	Pe
64.3	11.1	Pe
66.7	11.5	Me
85.5	12.2	B
89.6	11.0	Hu
98.6	12.4	Ba
1709.5	12.3	B

070122b
Z Gemin.

J.D. 242	Est.	Obs.
1661.3	12.4	Pe
64.3	12.3	Pe
66.7	12.8	Me
85.5	13.4	B
98.6	12.8	Ba
1709.5	<12.3	B

070122c
TW Gemin.

1661.3	8.0	Pe
64.3	7.7	Pe
66.7	8.3	Me
85.5	8.2	B
98.6	7.8	Ba
1709.5	8.1	B

070310
R Can. Min.

1636.3	9.6	L
65.3	9.1	L
70.3	9.1	L
86.5	8.4	B
90.6	8.2	Hu
98.6	8.0	Ba

071044
L² Puppis

1603.6	4.3	δ
44.6	5.7	δ
62.7	5.1	δ
69.6	4.8	δ

071201
RR Monoc.

1689.6	12.3	Ba

071713
V Gemin.

1688.5	<12.8	B
98.6	<13.4	Ba

072106
Nova Monoc.

1651.5	8.8	δ
51.6	8.9	δ
52.6	8.8	δ
55.6	8.7	δ
56.6	8.9	δ
57.6	9.0	δ
62.6	9.1	δ
63.5	9.1	δ
64.7	9.2	δ
66.6	9.1	δ
68.5	9.1	δ
69.6	9.1	δ

072708
S Can. Min.

1661.4	<11.3	Pe
64.3	12.0	Pe
70.4	12.0	Pe
98.6	13.0	Ba
1711.5	12.7	B

072811
T Can. Min.

J.D. 242	Est.	Obs.
1688.5	<12.5	Ba
98.6	<12.5	Ba

072820b
Z Puppis

1689.6	7.1	Ba

073508
U Can. Min.

1681.5	10.1	B
86.6	9.7	Y
90.6	9.9	Hu
98.6	9.6	Ba
1709.5	9.3	B

073723
S Gemin.

1627.5	9.9	Lt
41.3	10.1	Lt
88.6	<11.5	V
89.6	12.5	Hu
98.6	12.8	Me
98.6	12.6	Ba

074323
T Gemin.

1632.3	9.4	Lt
41.3	9.1	Lt
85.7	8.9	Wh
88.6	9.1	V
89.6	8.9	Hu
98.6	9.2	Ba
98.6	9.2	Me
1709.5	9.7	B

074922
U Gemin.

1633.3	<12.3	L
34.3	<12.3	L
35.4	<12.4	L
36.3	<12.3	L
43.3	9.7	L
45.3	<10.0	L
63.3	<11.7	L
65.3	<12.4	L
69.3	<12.3	L
70.3	<11.7	L
71.3	<11.7	L
72.3	<10.9	L
75.3	<10.0	L
77.3	<10.5	L
84.6	<13.7	Ba
85.5	<13.7	Ba
85.3	<12.3	L
85.5	<13.3	B
85.7	<12.3	Wh
86.6	<13.3	Ba
88.6	<11.7	V
89.6	14.2	Ba
89.6	<13.0	Hu

VARIABLE STAR OBSERVATIONS, Apr.-May, 1918—Continued.

U Gemin.

J.D. 242	Est.	Obs.
90.6	<13.9	Ba
91.6	<14.0	Ba
93.6	<11.7	V
97.6	<11.7	V
98.6	<13.7	Ba
98.6	13.7	Me
98.6	<12.3	Wh
99.6	<13.3	Ba
1710.6	<13.0	B
16.5	<13.7	Ba

075612

U Puppis

1686.5	11.4	B
89.6	11.5	Y
98.6	11.7	Ba
1710.5	11.9	B

080322

RV Puppis

1656.6	8.5	δ
62.6	8.5	δ
69.6	8.7	δ

081112

R Cancri

1627.5	10.2	Lt
40.4	9.4	Lt
89.6	6.9	Wh
92.6	7.5	Pt
96.6	7.0	Pt
98.6	6.5	Hu
98.6	6.5	Ba
1709.5	6.8	B

081617

V Cancri

1681.5	9.0	B
89.7	8.6	Wh
98.6	8.2	Ba
1709.5	7.7	B

081633

T Lyncis

1698.6	8.5	Hu

082405

RT Hydrae

1635.4	8.4	L
62.6	7.8	δ
63.3	8.2	L
69.6	7.8	δ
98.6	8.0	Ba

083019

U Cancri

1689.6	12.5	Y
98.6	12.2	Ba

083350

X Urs Maj.

1698.6	<12.8	Ba
1710.6	<12.6	B

083409

RV Hydrae

J.D. 242	Est.	Obs.
1662.6	8.1	δ
69.6	7.9	δ

084803

S Hydrae

1640.4	8.6	Lt
88.5	10.9	B
98.6	11.0	Hu
98.6	10.6	Ba
99.6	10.6	Me

085008

T Hydrae

1635.4	9.7	L
40.4	9.8	Lt
53.3	9.6	Lt
63.3	9.3	L
98.6	7.9	Ba
99.6	7.8	Me

085120

T Cancri

1665.3	9.1	L
81.3	9.2	L
89.6	8.5	Wh
89.6	8.1	Ba

090024

X Pyxidis

1689.6	9.2	Ba

090151

V Urs. Maj.

1634.3	10.2	L
63.3	10.4	L
64.2	10.4	Pe
71.3	10.8	L
98.6	10.4	Ba
98.6	10.0	Hu
1710.6	10.3	B

090425

W Cancri

1665.3	12.0	L
89.6	12.2	Wh
98.6	<13.5	Ba

092856

N Velorum

1603.6	3.0	δ
08.8	3.1	δ

092962

R Carinae

1603.6	5.1	δ
44.6	5.6	δ
56.6	5.5	δ
62.7	5.8	δ
69.6	5.9	δ

093014

X Hydrae

J.D. 242	Est.	Obs.
1662.7	12.0	δ
69.6	12.1	δ
98.6	<12.5	Ba

093178

Y Draconis

1689.6	9.4	Ba
99.6	10.0	Y

093934

R Leo. Min.

1627.5	6.9	Lt
40.4	7.2	Lt
63.3	7.9	L
92.6	8.0	Pt
96.6	8.4	Pt
98.6	8.0	Hu
98.7	7.1	Ba
1709.6	8.7	B

094262

ι Carinae

1603.6	4.0	δ
69.6	4.2	δ

094211

R Leonis

1627.5	10.2	Lt
35.4	10.1	L
41.3	10.1	Lt
61.3	8.9	Pe
63.3	9.2	L
66.3	8.8	Pe
70.4	8.8	Pe
71.3	9.2	L
86.6	7.9	Wh
86.7	8.3	Mu
92.6	8.1	Pt
96.6	8.4	Pt
98.7	7.1	Ba
98.6	8.4	Me
99.7	7.8	M
1700.7	8.1	Mu
08.6	8.0	Pt
10.6	6.9	B

094622

Y Hydrae

1669.6	7.0	δ
98.7	6.5	Ba

095421

V Leonis

1632.3	10.1	Lt
40.4	9.8	Lt
61.3	9.2	Pe
66.3	9.4	Pe
70.4	9.2	Pe
88.6	10.2	V
98.6	10.5	Hu
98.7	10.5	Ba
99.7	10.8	M
1709.6	11.0	B

100661

S Carinae

J.D. 242	Est.	Obs.
1603.6	6.1	δ
51.6	6.4	δ
56.6	6.3	δ
69.6	7.0	δ

101361

q Carinae

1603.6	3.8	δ
08.8	3.4	δ

103212

U Hydrae

1627.5	5.7	Lt
32.3	5.4	Lt
35.4	4.9	L
40.4	5.0	Lt
41.3	5.2	Lt
62.7	5.2	δ
63.3	4.7	L
63.3	5.0	Be
65.3	4.9	Be
65.4	5.6	Pe
69.3	5.0	Be
69.7	5.2	δ
91.3	5.1	Be
98.7	4.8	Ba

103769

R Urs. Maj.

1684.6	11.8	Ba
90.6	11.7	Ba
98.8	11.3	M
1708.7	10.0	M
11.8	9.8	M
16.6	8.8	Ba

104620

V Hydrae

1635.4	7.9	L
69.7	7.6	δ
98.7	7.8	Ba

104814

W Leonis

1686.6	13.0	Y
98.7	<13.0	Ba
1710.6	<12.6	B

115905

RX Virginis

1669.7	8.7	δ

115919

R Comae

1687.6	12.8	Y
90.6	<12.5	Ba

120012

SU Virginis

1688.6	<12.0	V
90.6	13.0	Ba

120206

RW Virginis

J.D. 242	Est.	Obs.
1669.7	7.4	δ

120905

T Virginis

1690.6	12.0	Ba

121418

R Corvi

1627.5	8.8	Lt
69.6	10.3	L
69.7	10.3	δ
90.6	10.8	Ba

122001

SS Virginis

1635.4	7.6	L
71.6	8.3	L
90.6	7.5	Ba
98.6	8.2	Hu
1710.6	8.3	B

122532

T Can. Ven.

1686.6	10.7	Wh
90.6	10.8	Ba
99.6	<11.3	M

122803

Y Virginis

1671.6	<10.8	L
90.6	<13.6	Ba

123160

T Urs. Maj.

1641 3	12.6	Lt
61.3	12.3	Pe
88.6	12.9	Y
90.6	12.8	Ba
98.8	<11.7	M
1716.6	12.0	Ba

123307

R Virginis

1627.5	7.6	Lt
35.4	7.4	L
40.4	7.8	Lt
61.4	8.6	Pe
64.5	9.0	Pe
65.4	9.0	Pe
71.6	9.7	L
90.6	10.4	Ba
98.6	9.4	Hu
98.7	9.9	Wh
1710.6	8.4	B

123459

RS Urs. Maj.

1661.3	10.1	Pe
64.3	10.3	Pe
85.6	11.1	Wh
90.6	11.5	Ba
98.8	11.5	M

VARIABLE STAR OBSERVATIONS, Apr.-May., 1918—Continued.

123961
S Urs. Maj.

J.D.	Est.	Obs.
242		
1634.3	11.1	L
41.3	10.4	Lt
61.3	10.8	Pe
63.3	11.0	L
64.3	10.9	Pe
71.3	11.1	L
85.6	11.0	Wh
88.6	10.8	Y
88.6	10.4	V
90.6	10.9	Ba
98.8	9.7	M
1711.8	8.9	M
16.6	8.7	Ba

124045
Y Can. Ven.

1602.4	6.0	Lt
27.5	5.1	Lt
40.4	5.1	Lt

124204
RU Virginis

1690.7	11.6	Ba
98.6	11.0	Hu
1710.6	10.7	B

124606
U Virginis

1627.5	9.2	Lt
64.4	11.6	Pe
65.4	11.6	Pe
85.6	12.6	B
90.7	12.6	Ba
98.6	12.5	Hu

131546
V Can. Ven.

1627.5	7.7	Lt
43.5	7.3	Lt

132202
V Virginis

1690.7	9.5	Ba

132422
R Hydra

1643.7	9.6	L
69.6	9.0	L
69.7	9.0	δ
98.7	7.8	Ba

132706
S Virginis

1627.5	7.5	Lt
40.7	7.7	Lt
43.7	7.7	L
71.6	8.5	L
90.7	8.8	Ba

133273
T Urs. Min.

1641.3	11.4	Lt
88.6	8.9	V
90.7	8.6	Ba
91.8	8.6	V
98.8	9.2	M

134440
R Can. Ven.

J.D.	Est.	Obs.
242		
1627.5	10.1	Lt
41.3	10.6	Lt
81.6	<10.7	B
86.6	11.5	Wh
98.8	11.6	M
1716.6	11.6	Ba

135576
θ Apodis

1603.6	6.1	δ
44 6	6.1	δ

135908
RR Virginis

1716.6	<13.3	Ba

140113
Z Bootis

1699.6	8.5	Y

140512
Z Virginis

1669.7	11.0	δ
89.6	9.9	Y
1716.6	10.0	Ba

140959
R Centauri

1608.8	8.7	δ
51.6	10.5	δ
69.6	<10.3	δ

141567
U Urs. Min.

1641.3	11.7	Lt
85.6	11.8	Ba
98.6	11.2	Wh

141954
S Bootis

1632.3	9.0	Lt
65.3	10.3	L
75.6	10.9	L
85.6	11.5	B
85.6	11.5	Ba
98.7	12.0	Wh

142205
RS Virginis

1689.6	8.8	Y
89.6	8.2	Ba

142539
V Bootis

1627.5	8.6	Lt
32.3	8.3	Lt
35.5	8.5	L
43.5	8.6	Lt
65.3	9.2	L
82.3	9.5	L
85.6	9.8	B
89.7	9.9	M
1716.6	10.5	Ba

142584
R Camelop.

J.D.	Est.	Obs.
242		
1628.5	10.1	Lt
41.3	11.1	Lt
1716.6	13.2	Ba

143227
R Bootis

1640.7	<10.4	Lt
89.6	7.5	Ba
89.7	8.1	M
91.7	7.9	Pt
97.7	7.5	Pt

143417
V Librae

1669.7	12.2	δ

144918
U Bootis

1689.6	10.6	Ba
89.7	10.6	M

150018
RT Librae

1669.7	11.4	δ
1716.6	<12.9	Ba

150519
T Librae

1669.7	<13.0	δ
1716.6	<12.5	Ba

150605
Y Librae

1716.6	9.2	Ba

151520
S Librae

1643.7	8.5	L
69.6	8.6	L
69.7	8.5	δ
75.6	8.6	L
1716.6	10.5	Ba

151714
S Serpentis

1689.7	12.2	M
1716.6	12.0	Ba

151731
S Cor. Bor.

1627.5	7.5	Lt
40.4	8.0	Lt
89.6	8.3	Ba
89.7	9.0	M
97.8	8.8	V
99.6	9.4	Y
1701.7	9.5	M
03.6	9.5	Wh

151822
RS Librae

1643.7	7.9	L
69.6	8.2	L
69.7	7.9	δ
75.6	8.5	L
1716.6	10.0	Ba

152714
RU Librae

J.D.	Est.	Obs.
242		
1669.7	8.8	δ
1716.6	11.8	Ba

153020
X Librae

1669.7	10.7	δ

153215
W Librae

1669.7	12.5	δ

153378
S Urs. Min.

1627.5	8.5	Lt
81.6	9.4	B
97.8	8.9	V
1716.6	10.1	Ba

153620
U Librae

1669.7	10.6	δ

154428
R Cor. Bor.

1627.5	8.8	Lt
28.6	8.8	Lt
40.7	9.1	Lt
43.5	9.3	Lt
43.7	9.0	L
44.7	9.3	Lt
50.5	9.6	Lt
65.4	8.3	Pe
66.6	8.2	Pe
69.7	8.6	L
70.4	8.0	Pe
71.7	8.3	L
75.6	8.3	L
84.6	8.1	Ba
85.6	8.0	Ba
85.7	8.4	Wh
86.6	8.1	Ba
88.8	8.4	M
89.6	8.0	Ba
89.7	8.4	Wh
89.8	8.4	M
90.6	7.9	Ba
91.6	8.0	Ba
91.7	8.1	Pt
93.6	8.4	Pt
97.7	8.1	Pt
97.8	8.2	V
98.6	8.1	Ba
98.7	8.4	Wh
99.7	8.0	Ba
1701.6	8.4	M
02.9	8.1	Pt
11.8	8.4	M
13.7	8.3	M
16.5	8.1	Ba
18.9	8.0	Pi
18.9	7.6	Re
18.9	7.3	De

R Cor. Bor.

J.D.	Est.	Obs.
242		
1718.9	8.1	M
18.9	8.3	Wh
18.9	8.2	Go

154536
X Cor. Bor.

1689.6	10.6	Ba
89.8	11.4	M
1701.6	11.1	M
03.6	10.7	Wh

154539
V Cor. Bor.

1688.8	7.9	M
89.6	7.8	Ba
1701.6	9.2	M

154615
R Serpentis

1628.6	8.9	Lt
40.7	8.3	Lt
44.7	8.0	Lt
50.5	7.8	Lt
89.8	6.5	M
97.8	7.5	V
1701.6	6.6	M
09.9	7.6	Pt
16.6	7.5	Ba

154736
R Lupi

1669.8	12.9	δ

155229
Z Cor. Bor.

1689.6	10.4	Ba

155847
X Herculis

1698.8	6.8	Mu
1702.7	6.8	Mu
12.7	6.8	Mu
16.6	6.3	Ba

160118
R Herculis

1716.6	<13.3	Ba

160210
U Serpentis

1640.7	8.9	Lt
44.7	8.9	Lt
89.6	11.0	Ba
89.8	10.8	M
1701.7	11.7	M

160325
SX Herculis

1628.7	8.8	Lt
40.7	8.7	Lt
44.7	8.6	Lt

VARIABLE STAR OBSERVATIONS, Apr.-May, 1918—Continued.

160625
RU Herculis
J.D. Est. Obs.
242
1689.6 12.7 Ba

161138
W Cor. Bor.
1689.7<12.5 Ba
99.6<11.8 Y

*161122*a
R Scorpii
1669.8 11.4 δ

*161122*b
S Scorpii
1669.8<12.8 δ

161607
W Ophiuchi
1716.6<12.5 Ba

162112
V Ophiuchi
1716.6 8.4 Ba

162119
U Herculis
1697.8<11.5 V
98.8 11.4 M
1716.6 12.2 Ba

162542
g Herculis
1627.5 5.1 Lt
44.7 4.8 Lt
98.8 5.9 Mu
1702.7 5.4 Mu
12.7 5.3 Mu

162807
SS Herculis
1689.7 10.7 Ba
99.7 10.6 Ba
1701.7 10.7 M
16.6 10.3 Ba

162816
S Ophiuchi
1716.7 10.0 Ba

163137
W Herculis
1689.7 12.7 Ba
99.6 11.6 Y
1701.7 11.5 M

163172
R Urs. Min.
1681.5 9.5 B
86.7 9.6 Wh
98.8 9.7 M
1716.6 9.4 Ba

163266
R Draconis
J.D. Est. Obs.
242
1641.3 11.3 Lt
86.6 8.0 Wh
89.8 8.4 M
99.6 8.3 Y
1716.6 8.5 Ba

164055
S Draconis
1628.5 9.2 Lt
89.8 8.7 M
98.7 8.7 Wh
1700.7 9.1 M
16.6 8.7 Ba

164319
RR Ophiuchi
1716.7<12.0 Ba

164715
S Herculis
1701.7 12.0 M
16.6 12.2 Ba

165030
RR Scorpii
1669.8 7.3 δ

165631
RV Herculis
1689.7<13.7 Ba

170215
R Ophiuchi
1716.7<12.0 Ba

170627
RT Herculis
1689.7 12.8 Ba

171401
Z Ophiuchi
1640.7 8.7 Lt
44.7 8.4 Lt
97.8 8.4 V
1702.8 8.0 M
16.6 8.3 Ba

171723
RS Herculis
1689.7 8.5 Ba
1701.7 9.8 M

172809
RU Ophiuchi
1716.6<12.6 Ba

175111
RT Ophiuchi
1716.6 10.8 Ba

175458
T Draconis
J.D. Est.Obs.
242
1689.6 9.5 Ba
89.8 9.2 M

175457
TY Orionis
1665.4 9.5 Pe

175458
UY Draconis
1689.6 11.4 Ba

175519
RY Herculis
1716.6 9.4 Ba

175654
V Draconis
1689.6 11.8 Ba

180531
T Herculis
1643.7 10.4 L
69.7 9.8 L
91.9 9.0 V
97.8 7.9 M
1709.9 7.3 Pt
16.6 7.1 Ba
18.9 7.6 Pi
18.9 7.8 Re
18.9 7.5 De
18.9 7.5 O
18.9 7.6 M
18.9 7.4 Go
18.9 7.5 Wh

180565
W Draconis
1689.7 11.3 Ba
98.6 11.6 Wh

180666
X Draconis
1689.7 10.8 Ba

181031
TV Herculis
1643.7<11.7 L

181103
RY Ophiuchi
1716.7 8.5 Ba

181136
W Lyrae
1688.8 7.6 M
98.8 7.7 M
1708.7 8.0 M
11.7 8.1 M
16.7 8.1 Ba

182224
SV Herculis
1716.7<13.0 Ba

182306
T Serpentis
J.D. Est.Obs
242
1716.7 9.3 Ba

183225
RZ Herculis
1716.7<12.5 Ba

183308
X Ophiuchi
1643.7 9.0 L
88.8 8.0 M
1716.7 8.0 Ba

184134
RY Lyrae
1716.7<13.5 Ba

184243
RW Lyrae
1716.7<13.5 Ba

184205
R Scuti
1625.7 6.1 Lt
40.7 5.9 Lt
43.7 6.0 L
44.7 5.9 Lt
69.7 5.8 L
69.8 6.2 δ
71.7 6.0 L
75.6 5.9 L
1702.8 5.2 M
02.9 5.1 Pt
09.9 5.0 Pt

185032
RX Lyrae
1716.7 12.0 Ba

185243
R Lyrae
1640.7 4.2 Lt

185634
Z Lyrae
1698.8<10.9 M

190108
R Aquilae
1711.8 6.5 M

190529
V Lyrae
1688.8 9.8 M

190926
X Lyrae
1702.8 9.0 M

191637
U Lyrae
1688.8 11.0 M

192745
AF Cygni
J.D. Est. Obs.
242
1628.3 7.4 Lt
32.3 7.4 Lt
40.7 7.2 Lt
42.3 7.2 Lt
50.5 7.1 Lt

192928
TY Cygni
1688.8 10.0 M
1711.8 10.9 M

193449
R Cygni
1641.3 11.9 Lt

193732
TT Cygni
1702.8 8.2 M

194048
RT Cygni
1641.3 11.6 Lt
97.8<11.1 V
1702.8 10.6 M

194348
TU Cygni
1688.8 9.9 M
97.8 9.0 V
1702.8 9.5 M

194632
χ Cygni
1640.7 7.4 Lt
44.7 7.3 Lt
88.8 4.8 M
97.8 4.4 M
97.9 4.8 V
1702.8 4.7 M
08.8 5.2 M
09.9 5.2 Pt
11.8 5.4 M

195849
Z Cygni
1632.3 9.5 Lt
40.7 9.4 Lt
88.8 10.5 M
97.9 10.8 V
1702.8 11.3 M

200212
SY Aquilae
1643.7<11.9 L
69.7 9.7 L

200647
SV Cygni
1688.8 9.4 M

VARIABLE STAR OBSERVATIONS, Apr.-May, 1918—Continued.

200715a
S Aquilae
J.D. 242 Est. Obs.
1688.9 10.3 M

200715b
RW Aquilae
1688.9 8.9 M

200938
RS Cygni
1640.7 8.8 Lt
71.7 7.7 L
88.9 7.6 M

200916
R Sagittae
1688.7 8.7 M

201130
SX Cygni
1688.8<11.4 M

201647
U Cygni
1641.3 8.0 Lt
88.8 7.0 M
1711.8 6.8 M

201808
R Delphini
1671.7<10.8 L

202539
RW Cygni
1688.9 8.9 M

202946
SZ Cygni
1688.9 9.6 M

202954
ST Cygni
1688.8<11.0 M

203226
V Vulpeculae
1688.8 9.0 M

203847
V Cygni
1632.3 8.4 Lt
40.7 8.3 Lt
41.3 8.3 Lt
88.8 8.4 M
1711.8 8.7 M

204016
T Delphini
1697.9 8.9 V

205030
UX Cygni
1711.8<11.3 M

205923
R Vulpeculae
J.D. 242 Est. Obs.
1640.7 9.0 Lt
44.7 8.6 Lt
88.9 9.4 M

210382
X Cephei
1689.5<13.0 Ba

210868
T Cephei
1628.5 6.4 Lt
42.3 6.5 Lt
65.3 6.7 L
75.6 7.4 L
1711.7 8.3 M

213244
W Cygni
1634.3 6.8 L
40.5 7.0 Lt
41.3 7.1 Lt
42.3 7.4 Lt
43.2 6.9 L
53.3 7.7 Lt
69.7 6.6 L
69.7 6.6 L
71.7 6.5 L

W Cygni
J.D. 242 Est. Obs.
1675.6 6.5 L

213753
RU Cygni
1688.9 9.0 M

213843
SS Cygni
1627.3 8.4 Lt
28.3 8.4 Lt
32.3 9.9 Lt
33.3 8.3 L
34.3 8.5 L
36.3 9.4 L
41.3 11.2 Lt
43.3<10.4 L
69.7 11.8 L
71.7 11.8 L
75.6<10.4 L
88.8 8.4 M
89.8 8.5 M
97.8 10.7 M
97.9<11.3 V
1711.8<11.3 M
16.7 11.6 Ba

213937
RV Cygni
1688.9 8.2 M

222439
S Lacertae
J.D. 242 Est. Obs.
1641.3 12.4 L

230759
V Cassiop.
1641.3 11.1 Lt

233815
R Aquarii
1603.5 8.6 δ

234716
Z Aquarii
1603.5 8.3 δ

235350
R Cassiop.
1632.3 10.1 Lt
40.4 9.2 Lt
43.5 8.8 Lt
44.4 8.6 Lt
50.5 8.0 Lt
53.3 7.3 Lt

235855
Y Cassiop.
1689.5<12.0 Ba

No. of Observations 859; No. of Stars Observed 255; No. of Observers 16.

A vote of thanks was extended to Mr. C. E. Barns for his general offer to publish gratis a booklet on Variable Star observing for the benefit of our new members. Miss Reed received a like vote for her kind offer to act as Assistant Secretary.

Messrs. Whitehorn and Campbell reported for the Chart Committee recommending the adoption of black and white prints obtained by a new method which will be free from the inaccuracies of the present set.

Mr. Campbell read an interesting paper on the variable 213843 SS Cygni and exhibited a number of curves illustrating points in the text. He also read a valuable paper contributed by Mr. Carlos S. Mundt, of Alameda, Cal., entitled "The Spectroscope as applied to Variable and Temporary Stars", which was greatly enjoyed.

It was voted to incorporate the Association under the laws of the State of Massachusetts and Mr. Jordan was appointed a Committee of one to prepare the necessary papers.

The following were elected by the Council Honorary Members of the Association:—

Miss Annie J. Cannon and Professor Solon I. Bailey, of the staff of the Harvard College Observatory, and Professor Henry N. Russell, Director of the Observatory of Princeton University.

Our membership now includes one hundred members.

The Association has been signally honored by the Committee on Grants of the American Association for the Advancement of Science in generously donating the sum of $300 for the purchase of a 5″ refractor to be loaned to an observer designated by our Association to promote the observation of Variable Stars.

The thanks and gratitude of our Association are herewith extended to the said Committee for this flattering recognition of the work of our organization.

Following the business meeting an opportunity was afforded of observing in Mr. Pickering's well equipped observatory. Those who stayed over Sunday morning were favored with a delightful ride to Montclair and Glen Ridge.

A print of the illustrious Kepler, provided by Mr. McAteer, was the Souvenir of the meeting.

Mr. Lacchini of Faenza, Italy, is to be congratulated on the publication of a large number of his observations with which he has kindly favored us to incorporate in our records.

Mr. Dawson contributes this month a splendid set of observations of southern variables including a number of valuable estimates of the light of Nova Monocerotis.

The observation of the southern variables is of extreme importance and valuable work in this field is now being accomplished by the well known observers Long and Sjkellerup, to whom the Association extends its deep appreciation.

Lists of exceptional merit were received this month from Messrs Bancroft and McAteer.

The thanks of the Association are due Mr. C. E. Barns for a generous supply of stationery bearing the seal of the Association for the use of the Secretary.

Mr. Schulmaier is to be commended for his efforts as Historian to secure a permanent record of the features of interest concerning the personnel of the Association, and cards will shortly be sent to all our members to be filled out and returned to the Historian to complete this record.

The following dates of Maxima and Minima calculated by Mr. Leon Campbell are of interest:—

May	2	163266	R Draconis	Max.	May	18	081617	V Cancri	Max.
	5	*021403 o*	Ceti	Min.		23	050953	R Aurigae	Min.
	8	222439	S Lacertae	Max.		26	084803	S Hydrae	Min.
	16	162807	SS Herculis	Min.		30	081112	R Cancri	Max.

The Association is well represented in the Service and proud of its Honor Roll which now contains the names of Messrs Binger, Eaton, French, Hay, and Houdard.

The following members contributed to this report:—Messrs. Bancroft, Benini, Boulon, Dawson, De Perrot, Hunter, Lacchini, Luyten, McAteer, Meeker, Mundt, Peltier, Vrooman, Whitehorn, Miss Young.

WILLIAM TYLER OLCOTT.
Secretary.

Norwich, Conn.
May 10, 1918.

COMET AND ASTEROID NOTES.

A Faint Asteroid and Possible Telescopic Comet.—These two objects were recently found on a couple of plates taken with the Metcalf 16-inch doublet at Cambridge on January 16 and 17, 1917. Unless a third observation of them is available, the positions given below are necessarily of little value. Both objects were of about the thirteenth magnitude, and the genuineness of the asteroid is unquestioned, since it left a trail on each plate. The appearance of a comet might be due to two similar photographic defects which happened to occur within a millimeter or so of one another on the two plates. The plates contain no other defects of this character, and the object looks like a comet. The general interest taken in these objects, and the possibility that a photograph taken on a third date may be found elsewhere, perhaps justifies the publication of this note. The first and last position are in each case extrapolated, the middle one observed.

1917	Asteroid				Comet			
	h	m	°	′	h	m	°	′
Jan. 7	7	16.2	+27	16	7	25.0	+29	28
17	7	6.2	27	36	7	22.7	29	10
27	6	56.2	27	56	7	20.4	28	52

WILLIAM H. PICKERING.

Mandeville, Jamaica.
April 19, 1918.

Elements and Ephemeris of Wolf's Object 1918 DB.—In the *Lick Observatory Bulletin* No. 309, Mr. H. M. Jeffers gives new elements of Wolf's object, based upon observations by Barnard on February 12, 21, and March 7. The elements represent 32 observations from February 5 to March 16 fairly well, excepting three which are evidently vitiated by errors of measurement or reduction.

ELEMENTS.

Epoch = 1918 Feb. 21.8242 Gr. M. T.
M_o = 12° 0′ 59″
ω = 347 45 05
Ω = 110 53 50 } 1918.0
i = 8 58 10

ϕ = 32° 15′.42″
log a = 0.404070
μ = 878″.824
Period = 4.0374 years
T = 1918 Jan. 3.6005 Gr.M.T.

The portion of the ephemeris for June is as follows:

	α			δ		log Δ	Mag.
	h	m	s	°	′		
June 1.5	11	16	41	+16	26.1		
3.5		19	55	15	57.3	0.2131	16.2
5.5		23	09	15	28.6		
7.5		26	22	15	00.0		
9.5		29	34	14	31.5		
11.5	11	32	46	+14	03.1	0.2468	16.5

With regard to the satellite reported by Wolf, Mr. Jeffers says: "No American observer has so far reported the existence of such a companion, nor, apparently, has any other European observer. There is slight evidence of periodicity in the residuals, but no definite conclusions are warranted until the residuals shall have been computed more accurately. There is a further difficulty in the fact that the mass of an object which could hold a satellite at the distance given by Wolf, and with such a rapid change in position angle, would have to be considerable, a thing which is not in harmony with the observed faintness. It appears impossible to make any decision at the present time, as to whether Wolf's satellite is physically connected to the principal object or not."

Discovery of Minor Planets in 1917.—Fifty-four minor planets were discovered or first announced in 1917. Twenty-four of these have received permanent numbers, bringing the total number of asteroids for which fairly good orbits have been calculated up to 876. Besides the 876 numbered planets, 19 more have elliptical orbits calculated and 54 more have circular orbits calculated, making a total of 949 orbits.

As usual Professor Max Wolf, of the observatory at Königstuhl, Germany, leads the list of discoverers, with 41 new asteroids found in 1917. Two of these were found independently by Dr. Schorr, at Bergedorf, Germany. Three were found by Professor Palisa at Vienna, and one by Mr. Comas Sola, at Barcelona. Of those found in 1916, but not announced until 1917, seven were discovered by Beljawsky, of the Simeis Observatory, Crimea, and one by Mr. G. H. Peters, at the U. S. Naval Observatory, Washington, D. C.

Discovery of Comets in 1917.—1917 *a*. The first cometary discovery of the year was made by Mr. J. E. Mellish at Leetonia, U. S. A., on March 19. It was then of the eighth magnitude and brightened rapidly, so that on April 4 it reached magnitude 2.2, and was independently discovered with the naked eye by Mr. Adolf Paetz. On passing to the south of the Sun it was a very fine object in the morning sky for southern observers, with a curved tail 20° in length; it was independently rediscovered at various places in South Africa, Australia, and New Zealand. Its perihelion distance was small (0.19), which accounts for its rapid rise in brilliance. It is probably periodic, with a period in the neighborhood of two centuries, but cannot be identified with any comet in our catalogue. It was observed till the end of May.

1917 *b* was discovered by M. A. Schaumasse at Nice on April 25. It was described by M. Guillaume as a circular nebulosity, of yellowish tint, with a central condensation. It was well placed for observation during May, being in high north declination. Owing to its retrograde orbit and a fairly close approach to the earth (about 0.3), its motion was very rapid. Its magnitude is given by Holetschek as 8.5 on May 12, 8.0 on May 18, 7.3 on May 19. Mr. W. H. Steavenson considered that it just reached naked-eye visibility. Mr. F. E. Seagrave has noted that its orbit and that of the earth approach each other closely at the point occupied by the earth on March 30. It was observed till the end of June.

Wolf's Comet (*b* 1916), discovered in April 1916, did not reach perihelion till mid-June 1917. It was under observation for almost a whole year, but never became brighter than the eighth magnitude. Its light was sometimes noted as bluish, and there was evidence of occasional variability of brightness. A short tail was

seen on several occasions. On June 15 it was noted by Mr. W. H. Steavenson as being broad and fan-shaped, 5′ in length, in P. A. 250°. Professor Slipher obtained photographs of the spectrum in August at Flagstaff; it was chiefly continuous, but showed faintly the cyanogen band at λ 3883, and a trace of the carbon one at λ 4737. The spectrum was too narrow and faint to show the solar lines, but it was concluded that the comet's light was chiefly reflected sunlight. Mr. F. E. Seagrave has noted that it made a fairly close approach to Vesta in 1917 November.

1917 *c* (Encke) was discovered by Dr. Schorr at Bergedorf on December 30; it was of the fifteenth magnitude, and agreed within about 1′ with Viljev's ephemeris. Minor planet CP, discovered in September, was at first announced as Encke's Comet, but its divergent motion soon disproved the identity. M. Viljev has shown that the object observed in September 1916, and announced as Encke's Comet near aphelion, cannot really have been that comet, but was either an unknown comet or a faint minor planet. (A. C. D. C. in *Monthly Notices* of the Royal Astronomical Society for February 1917.)

COMMUNICATIONS.

The Star of Bethlehem.—It is not likely that there will ever be a satisfactory explanation of the "Star of Bethlehem." This phenomenon will probably stand for all time as a perpetual challenge to theologians and astronomers. Mr. Hagar's attempt to solve this difficult problem, while interesting and ingenious, implies a degree of celestial familiarity on the part of the Gospel writers which, to say the least, is difficult to reconcile with the traditional views of their intelligence. His further conclusion that we should accept the reference to the shepherds and their flocks in the second chapter of Matthew as "merely a poetic reference to the constellation Aries", because of the cold and inclement weather in Palestine in the winter season, is hardly justified by the facts.

A Roman monk living in the sixth Century A. D. is credited with having first made the attempt to fix a date for the Nativity. He claimed it was in the year 573 after the building of Rome, but that this is not the correct year has been abundantly proved, neither is December 25 the correct day; at least there is no evidence whatever to prove this date as the birthday of our Lord. Surely then it is futile to argue that the Gospel writers had only in mind the winter season when they wrote their simple narrative of this central event in the world's history. The fact that Christendom centuries ago adopted December 25 as the natal day is scarcely a warrant for blind acceptance without corroboration. It is the event we celebrate, and not the day. A similar instance of Biblical misunderstanding is the chronology recited in the margin of the old King James version of the Bible, which begins with the statement that the world was created in the year 4000 B. C. Many generations of devout Christians erroneously pinned their faith to this deduction of Bishop Ussher, which long since collapsed under the test of criticism.

S. C. Hunter.

GENERAL NOTES.

Director William Wallace Campbell, of the Lick Observatory, University of California, has been elected a foreign member of the Royal Society.

Professor Forest R. Moulton, of the department of Astronomy and Astrophysics of the University of Chicago, has been granted leave of absence for one year, from April 1, 1918. He is commissioned major in the Ordnance Reserve Corps of the United States Army, and will have the duty of directing the computation of range tables and ballistic data.

Professor W. A. Cogshall, of Indiana University, delivered recently an address before the St. Louis Academy of Science on "The problems of the total solar eclipse with particular reference to the corona and the intra-mercurial planets." (*Science* Apr. 26. 1918.)

Mr. Robert Meldrum Stewart, of the Dominion Observatory, Ottawa, Canada, has been appointed Assistant Chief Astronomer. He has been connected with the staff of the Dominion Observatory since 1903.

Professor R. G. Aitken, and **Professor H. N. Russell** have been elected members of the National Academy of Sciences.

Dr. Frank Schlesinger has been elected a foreign member of the Società degli Spettroscopisti Italiana.

Dr. Walter A. Mitchell has entered the Aviation Service and will be stationed at Rochester, N. Y.

The Death of M. E. F. van de Sande Bakhuyzen, director of the Observatory of Leyden, is announced by letter of date March 3, 1918. He was Doctor of Sciences and Professor extra-ordinaire at the University of Leyden, Professor W. de Sitter is director of the Observatory in the interim.

Mr. O. L. Petitdidier, a maker of scientific instruments, of Chicago, Illinois, a member of the American Astronomical Society, died on May 23, 1918.

The 72-inch Mirror Completed.—From the May-June number of the *The Journal* of the Royal Astronomical Society of Canada we learn that the great 72-inch mirror for the reflecting telescope of the Dominion Astrophysical Observatory, Victoria, B.C., has been completed. It was shipped from Pittsburgh on April 18 and is doubtless now in place on Observatory Hill.

A New Unit of Stellar Distance.—In *L'Astronomie* for December, 1917, Mr. De Rey Pailhade, of Toulouse, France, proposes as the unit of stellar distance 10^{10} kilometers. A light year would be 946×10^{10} kilometers, or approximately 1000 units of stellar distance, a number easy to remember.

A parsec in the same unit would be 3.25×946.7, or 3078; roughly 3000×10^{10}.

The abbreviation Us is suggested for "Unit of stellar distance," so that on this plan the earth's distance from the sun would be 0.015 Us; that of Neptune 0.450 Us; that of 61 Cygni 5865 Us, etc.

We may question however, whether this is any improvement over the "parsec" as a unit. The parsec is directly connected with the parallax of a star. As soon as one sees a star's parallax expressed in decimals of a second he may instantly know that the distance is the reciprocal of that number. For example if the parallax is 0″.11, the distance is 9 parsecs. This may be converted into miles if one wishes by multiplying by 20 trillions (20×10^{12}), or into kilometers by multiplying by 30 trillions (30×10^{12}).

The Growth of a National Physical Laboratory (The approximate British equivalent of the U. S. Bureau of Standards) was set forth in a recent lecture by the director, Sir Richard Glazebrook. As recently as the year 1901 the staff comprised three scientific assistants, working in some small rooms at Kew Observatory, together with the former staff of the observatory (since transferred to the Meteorological Office). The income was then about £5,000. On April 1, 1918, the staff was organized in eight different departments, each with its own superintendent and a large corps of scientific assistants and observers; a total of more than 500 persons, of whom about 180 are women. The annual expenditures now amount to more than £100,000, having increased from £38,000 since the beginning of the war. The laboratory has, of course, done a large amount of special work occasioned by the war, including very important investigations in aeronautics, the details of which are at present kept secret. Sir Richard says that "when the day comes on which the tale can be told, it will form a striking example of the work of a laboratory of industrial research, and the results obtained for purposes of war will bear fruit in the rapid progress of civilian aircraft." The laboratory has five air channels in nearly continuous use, and more are being erected. In spite of the name "National" this laboratory has heretofore been maintained chiefly by the Royal Society and six technical societies. On April 1st of the present year its property was vested in the Imperial Trust for the encouragement of Scientific and Industrial Research, while its finances passed under the control of the Committee of the Privy Council for Scientific and Industrial Research. The work of the laboratory will, however, still be supervised by the Royal Society and an executive committee including representatives of the leading technical societies. (*Scientific American*, May 18, 1918.)

A Proposed Change in the Calendar.—From time to time during the past decade the proposal has come up in various scientific gatherings to change the present calendar into one in which the days of the month should occur on the same days of the week in succeeding years. In POPULAR ASTRONOMY, Vol. XX, No. 4, Mr. R. E. Wilson gave a brief discussion of the subject and described the plan proposed by Professor Grosclaude. A somewhat similar plan has now been placed before the United States House of Representatives in the form of a bill introduced April 16 by the Hon. J. M. C. Smith, of Coldwater, Michigan. According to *Science*, May 17, the bill provides as follows:

1. That beginning with the year nineteen hundred twenty each year shall have thirteen months of four weeks, or twenty-eight days each, the added month to be called Sol (from Solstice) and to follow June.

2. That Monday shall be the first day of the week and the first, eighth, fifteenth and twenty-second days of every month; the other days of the week to follow in rotation by number, making Sunday the seventh day of the week and the seventh, fourteenth, twenty-first and twenty-eighth day of every month.

3. That the day following the last day of December, nineteen hundred and nineteen, and the last day in each subsequent year shall be called New Year Day. It shall be legal holiday, the first day of the new or following year, but not a part of January.

4. That in the year nineteen hundred and twenty and every fourth year thereafter shall be an extra day called Leap Day, to be placed between June and Sol, but not to be a part of either month: *Provided*, that there shall be no Leap Day in the last year of any century that is not divisible by four.

While we do not believe that the time has come for such a radical change in the Calendar to be accepted by the people in general, we see no serious objection to the proposed plan if all peoples could be induced to adopt it at the same time. To have one nation adopt it and others reject it would lead to endless confusion. It would be far more serious to have different days in the week in different nations, than to have different days in the month and year as has been true to some extent since 1582. To have that difference progress every year by one or two days would make confusion worse confounded.

An Observatory Bombarded.—The *Astrophysical Journal* for March 1918 contains the following account concerning the bombardment of the Poulkova Observatory on November 12, 1917.

"Disquieting rumors regarding the safety of the observatory at Poulkowa reached this country in brief press dispatches during the early winter. We are now happy to be able to state* that the dangers due to the civil strife had thus far been passed without serious damage to that famous institution. It is, however (as it should be!), very unusual for an astronomical observatory to be under artillery fire, and it can hardly be an indiscretion to give our readers the following particulars:

"Rumors had reached the astronomical colony at Poulkova, which lies about 20 km southwest of Petrograd, that bodies of Cossacks were coming toward the capital to restore the ministry of M. Kerensky. The garrison from the village of Zarskoje Selo (site of the summer residence of the the former emperor) presently arrived at Poulkova, having been driven out by the Cossacks. On November 11 soldiers from the garrison of Petrograd, with the Red Guard and with artillery, arrived for the relief of that body of troops.

"With a zeal which we may imagine must have seemed to the astronomer in excess of its wisdom, those forces from the capital surrounded the observatory on all sides, and established batteries of artillery within 400 or 500 meters on both sides of the main building.

"Between one o'clock and five-thirty on the afternoon of November 12 the observatory was under an intense artillery fire from the Cossacks. Fortunately, none of the instruments were damaged, although a shell burst beside the brick foundation

* As of November 23, 1917.

of the dome of the large astrographic telescope. Many holes were made in the dome of the great refractor and in the roof of the director's office. The wall of the seismological station was pierced, and we may believe that the instruments registered their largest earthquake. Of course there was much damage to windows. The ground was torn up by numerous holes of a diameter of a meter. The Cossacks retired on the following day.

"The director of the observatory had been able in the preceding days to foresee the dangers of the situation, and had removed the 30-inch objective, as well as the objectives of the other instruments. By a singular good fortune no one of the personnel of the observatory or colony was injured during these exciting events.

"It was felt that there was no guaranty that such events might not recur under the present conditions in Russia. Men of science everywhere will certainly wish to join with us in our satisfaction that no more serious damage was done and in offering our congratulations on this escape to Director Belopolsky and his staff, with the hope that the admirable work carried on at the observatory during the last eighty years may continue unimpaired, despite the political and economic changes through which Russia is passing. F."

Orbit of the Double Star Σ 1879 = *B* 6999.—In the *Astronomical Journal* No. 734 Professor G. C. Comstock, director of the Washburn Observatory gives the following new elements of the double star Σ 1879, which is No. 6999 of Burnham's General Catalogue.

$$\left.\begin{aligned} \Omega &= 53°.4 \\ i &= 60\ .4 \\ \omega &= 228\ .6 \\ e &= 0.778 \end{aligned}\right\} 1900.0 \qquad \begin{aligned} a &= 1''.10 \\ T &= 1871.0 \\ P &= 240 \text{ years} \\ n &= 1°.50 \end{aligned}$$

The following is an ephemeris for the coming 25 years:

	Pos. Ang.	Dist.
	°	″
1910.0	124.6	0.64
1915	118.7	.70
1920	113.8	.77
1925	109.7	.83
1930	106.2	.89
1935.0	103.0	0.96

Undesirable Visitors.—In Dr. John Evershed's report as director of the Kodaikánal Observatory for the year 1917 occurs the following unusual paragraph:

"The Observatory was visited during the year by a tigress and two cubs. They arrived by the north meridian mark, and killed a cow at the well."

A "Siderail" Clock.—Newspaper mistakes in regard to scientific terms are often ludicrous. This one found in a Toronto daily paper which every week prints mistakes found in other papers, is a new one:

"CAN'T MOVE THIS CLOCK."

"All the clocks at the Observatory except one were moved ahead one hour at one o'clock on Saturday, in accordance with the daylight saving law. The one that was not moved on is the siderail clock, whose time is regulated by the stars."